

Knowing Your Trees

BY G. H. COLLINGWOOD
AND WARREN D. BRUSH

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51 TREE EDITION KNOWING YOUR TREES

By

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and

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With 268 illustrations showing typical trees
and their leaves, bark, flowers, and fruits



THE AMERICAN FORESTRY ASSOCIATION

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FOREWORD

We Americans are an outdoor-loving people. At every opportunity we turn to natural beauty for relaxation and enjoyment. Some find it in their own gardens, in the surrounding countryside; others follow highways and byways to distant forests and parks. But whether at our own doorstep or at timberline on some mountain peak, the greatest single factor in this quest is trees.

As individuals, trees shelter and beautify our homes, shade our streets and highways, give charm and dignity to our parks, life and character to our landscapes; in tree communities they form our hillside woodlands, our forests that sweep to the horizon. Just as products of the forest contribute in a thousand and one ways to our day-by-day life, so do living trees contribute at all seasons of the year to our relaxation and enjoyment.

Thus to know more about trees is to greatly enhance the pleasure we derive from them. And to this purpose KNOWING YOUR TREES is dedicated — to bring to the American people, in picture and in story, the characteristics and important contributions to society of 51 of their most important trees. This collection includes 51 of America's most popular trees. Identification is made easy by actual photographs of the tree, both winter and summer, its leaves, fruit, bark and, when significant, its flower. To obtain such an understanding collection of photographs The American Forestry Association for years has been searching collections and working directly with photographers in every corner of the nation.

Initial work on KNOWING YOUR TREES was begun in 1932 by G. H. Collingwood, then forester for the Association, and in 1937 the first edition was issued. This was revised in 1941. At this juncture Dr. Warren D. Brush, nationally recognized authority on woods, took up the work and contributed material for additional trees. Thus the present members edition is the combined work of Collingwood and Brush. The Association also publishes a larger edition of KNOWING YOUR TREES containing 151 different trees. Cloth bound, with colorful dust jacket, this volume is available at \$5 per copy.

Common and scientific names as used in the text conform with those accepted and published in *Standardized Plant Names* as prepared for the American Joint Committee on Horticultural Nomenclature, although in several cases common names in widespread usage have been retained.

Sources of photographs have been acknowledged throughout with this exception: The photographic collection of the U. S. Forest Service has been drawn upon so heavily that credit for individual pictures from this source has been omitted. Accordingly, all unacknowledged pictures should be credited to the U. S. Forest Service.

Taxodium distichum, (Linnaeus) Richard

THE baldcypress, equally at home on land or in the water, lifts a massive, buttressed, tapering trunk, surrounded by curious cone-shaped knobs, above the stagnant water of southern swamps or river bottoms to carry a crown laden with drooping locks of Spanish

moss. This remnant of ancient times, when similar trees were distributed over North America and northern Europe, is making its last stand in the southeastern states where it grows along the coast from southern Delaware to southern Florida, westward along the Gulf Coast into

Texas, and northward up the river valleys through Oklahoma and Arkansas to southern Illinois and southwestern Indiana. Usually it occurs along low bottomlands in saturated, or seasonally submerged soil. Thousand year old trees may become 150 feet high and twelve feet in diameter, but more often they approach 120 feet in height and three to five feet in diameter. In youth the crown is narrow and pyramidal, but with age the branches spread to form a broad irregular crown.

Although a conifer it is not evergreen, for its leaves and small immature twigs are shed each fall. The only other deciduous conifer, the larch, sheds only its leaves.

The scientific name *Taxodium* comes from its resemblance to the yew or *Taxus*, while *distichum* is from two Greek words meaning twice or double ranked, and refers to the two-ranked arrangement on the twigs of the long, narrow, rather flat leaves. These are one-half to three-quarters of an inch long, light yellow-green, arranged spirally on the twigs, and feathery in appearance. They turn yellow or brown before they drop in the autumn.

In the spring each tree may carry male and female flowers which develop on twigs of the preceding year's growth. The male flowers are in slender, purplish, tassel-like clusters, three to six inches long, while the female or ovulate flowers are scattered near the ends of the branchlets. These develop in a single season into spherical, purplish cones about an inch in diameter. Thick rhomboid scales fit closely together and under each may be two light brown, winged, somewhat pyramidal, horny seeds. Cypress also sprouts freely from the tree stumps during the first fifty to one hundred years.

Small, brown and more or less egg-shaped leaf buds appear on light green, slender twigs, which by winter become light red-brown and lustrous.

The reddish brown, fibrous ridged bark of old trees peels off in long strips, and is one to two



The massive, buttressed trunk of the Baldcypress supports a broad irregular crown of light green feathery foliage

inches thick. On younger trees the bark is light brown, less deeply ridged and thinner.

Shallow serpentine roots spread out from the buttressed base of the tree. Where water stands during part of the year these develop sharp, elongated cones or "knees" which rise a few inches to five or six feet above the mud surface, corresponding to the high water level of the locality. They are covered with thin bark, are hollow, and usually die when water is permanently drained or when the parent tree is cut. They help anchor the tree and are believed to furnish air to the roots. In spite of the unstable soils in which cypress thrives, even the tallest trees are seldom thrown by the wind.

The soft, narrow-ringed, pale brown to reddish wood weighs twenty-two to thirty-seven pounds to the cubic foot when air dry, averaging about twenty-eight pounds. It is easily worked, has no resin ducts, feels slightly greasy or waxy, and has a peculiarly rancid odor. The heartwood is so durable in contact with the soil, or when exposed to the weather, as to be known as "the wood eternal." Cypress is used for structural purposes, for flooring, water tanks, ships, cross-ties, shingles, coffins, laundry appliances and greenhouse equipment.

More than half the estimated stand of 6,236,000,000 board feet is located in Florida and South Carolina. In 1946 the lumber cut amounted to about 212,000,000 board feet. It is produced chiefly in Florida, Louisiana, South Carolina, North Carolina, Mississippi and Tennessee. In 1936 the cut was 441,000,000 board feet, while in 1913 it exceeded a billion feet.

Baldcypress trees may grow in relatively pure stands in swampy areas or in mixture with tupelo gum, green ash, willow, overcup oak, red gum, the soft maples and elms. Single acres with over 100,000 board feet have been measured, while forty-acre tracts have yielded 1,500,000 board feet. Usually, however, stands do not exceed 8,000 to 10,000 board feet to the acre.

This last representative of an ancient race resists most insect enemies, but is subject to a heart-rot fungus which fills the wood with holes to be known as "pecky" cypress. This has many uses where strength or ability to hold water are not essential. The thin bark offers little protection against fire and during years of drouth when swamps are dry great quantities of timber are burned.

Cypress is successfully planted throughout its range for ornamental and roadside purposes and individual specimens are proving hardy in central New York and over much of Indiana and Illinois.



Purplish woody, spherical cones about an inch in diameter are borne on the twigs of the previous year's growth. Each cone may yield eighteen to thirty light brown, winged seeds



The fluted, buttressed trunk and the "knees," which often protrude above the mud and water, are covered with fibrous, reddish brown bark. The "knees" are hollow and are part of the shallow roots. They are believed to furnish air when the base of the tree is submerged



Natural range of Baldcypress

CALIFORNIA INCENSECEDAR

Libocedrus decurrens, Torrey



THE TALL, compactly columnar crown of incensecedar, consisting of flattened frond-like branches, and reared on a rapidly tapering cinnamon-red trunk is frequently seen growing singly or in small groves over the western slopes of the mountain ranges from northern Oregon to lower California. Confined largely to elevations of 4,000 to 8,000 feet above sea level, it ranges for a thousand miles from the basin of the Santiam River in Oregon, southward along the Cascade Mountains and the western slopes of the Sierra Nevada, over the California coast ranges to the mountains of southern California and Lower California. Eastward it is found in a few scattered mountain areas in Nevada.

Mature trees range from seventy-five to 110 feet in height and from two and a half to four feet in diameter. Trees 150 feet in height occur throughout the Sierra and one tree 186 feet high has been recorded. The younger trees with trunks up to twelve inches in diameter maintain a narrow, columnar form with branches reaching to the ground. The larger branches have a distinct upward turn. With age and maturity, the crown flattens out and becomes more open. Incensecedar is a relatively slow-growing tree reaching an average diameter of about thirteen inches in 100 years and frequently attaining ages of 300 to 500 years. One tree measuring fifty-one inches in diameter at stump height was 542 years old, and trees may reach ages ranging from 800 to 1,000 years.

The yellowish green evergreen foliage consists of small, pointed, scale-like leaves adhering closely to slender branchlets and capable of remaining on the tree from three to five years. They form flat sprays. Each leaf extends from one-eighth to one-half inch along the branch and has a characteristically long base to which the technical name *decurrens* refers. A small resin gland on each leaf is responsible for the pungent, aromatic odor so apparent when the leaf is crushed.

Libocedrus is the name of a widely distributed family of trees closely related to the true cypress and not far distantly to the *Thuja*. *Libocedrus decurrens* is the only one of the nine species of the genus which is native to North America. Eight other species are found from Chile to Patagonia in South America, China, Formosa, New Guinea, New Zealand, and New Caledonia. *Libocedrus* is derived from two Greek words and may be translated as "the cedar tree, the wood of which was burnt for perfume or to scent ointment."

Flowers of the two sexes are found on parts

California Incensecedar attains heights of 150 feet in the coast ranges of Oregon and California

of the same tree, or occasionally upon different trees. In January the quarter-inch long, golden yellow, pollen-bearing male, or staminate flowers shower the tree with gold and mingle with the snow as it lies on the branches. The female flowers develop on the ends of the past year's growth, as small light yellow-green cones with two to six pairs of leaf-like scales.

By late summer, following the appearance of the blossoms, small urn-shaped cones, from three-quarters to one and one-half inches long, develop and hang pendent on the extreme ends of the branchlets. These cones somewhat resembling those of *Thuja*, or white cedar, but with fewer scales, consist of six leaf-like scales in pairs, and enclose one or two tiny, winged seeds. By September the cones open and great numbers of seed drift down in the wind in such quantities as to form a red-brown carpet beneath the parent trees. The dry, yellow-brown cones cling to the trees for several months thereafter.

The widely buttressed bases of mature incensecedar trees are clothed in thick, shreddy, cinnamon-red bark which is deeply grooved and ridged. On young trees the bark is purplish red, flaky, and has a silver sheen on the loosened scales. Later it takes on a reddish brown hue which glows in the sunlight. The upper bark of old trees is two or three inches thick, while along the base it may be six or eight inches thick.

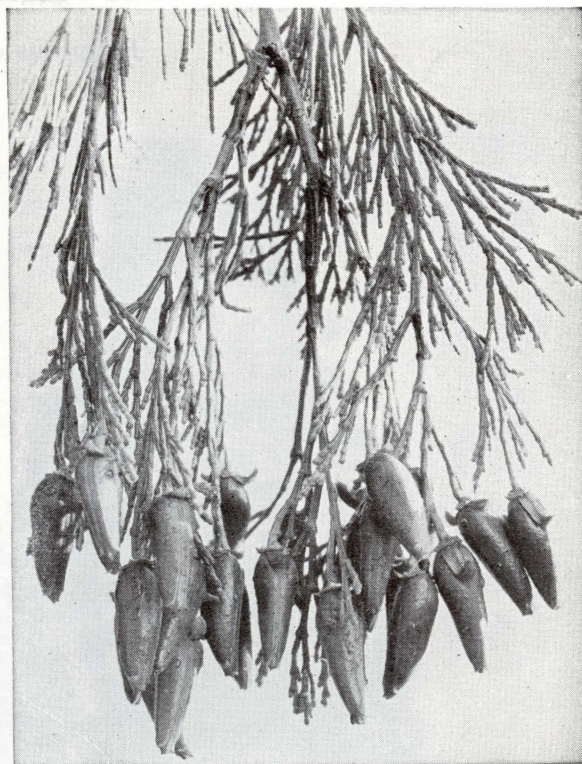
The soft, light brown wood is frequently tinged with red, although the sapwood is cream colored. It has a compact, fine, straight grain, splits readily and evenly, and does not check or warp in seasoning. The wood weighs, when air dry, about twenty-five pounds to the cubic foot, is aromatic, takes a good polish and is extremely durable when seasoned. It is widely used for fence posts, railroad ties, shingles, and to an increasing extent for pencil slats, cedar chests, so-called moth proof linings for the interiors of wardrobes, and for door and window frames. It is sometimes used for cigar boxes. The stand of California incensecedar has been estimated at 9,700,000,000 board feet, with 7,370,000,000 in California and 2,300,000,000 in Oregon. The average annual lumber production for the period 1933 to 1942, is estimated at 30,000,000 board feet. For the years 1940 to 1943 it was about 44,000,000 board feet because of war demands. Probably about 5,000,000 board feet additional is cut annually for fence posts and railway ties.

Under the most favorable conditions it may form half of the stand in mixture with ponderosa pine and sugar pine. It is also found in mixtures with the giant sequoia, California black oak, Jeffrey pine, and occasionally with white fir, lodgepole pine, and limber pine. Best development is found on the west slope of the Sierra at elevations of 5,000 to 6,000 feet above sea level.

The thick, fire-resistant bark makes mature incensecedar trees relatively immune to fire damage, but heavy losses are sustained when fire runs through young growth and reproduction.

There are no insect enemies of any importance, but practically one-half of all incensecedar trees as they stand in the woods are defective, and most of the loss is due to a dry rot fungus which attacks the heartwood, excavating parts throughout the length of the trunk.

Incensecedar has been extensively planted for ornamental purposes in the eastern states where it prospers as far north as Massachusetts. The tree lends itself to unusual landscape effects, does well on well-drained, loamy soils, and is highly tolerant of shade.

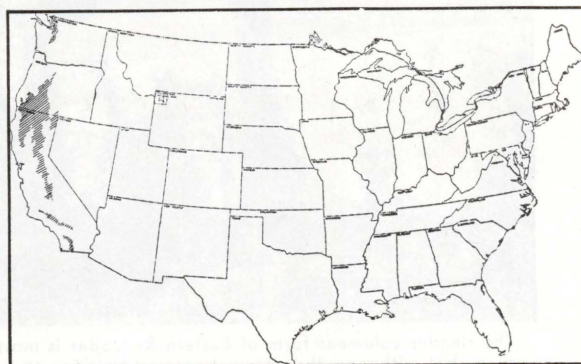


George C. Stephenson

Light brown cones develop in one season and hang from the ends of the branchlets



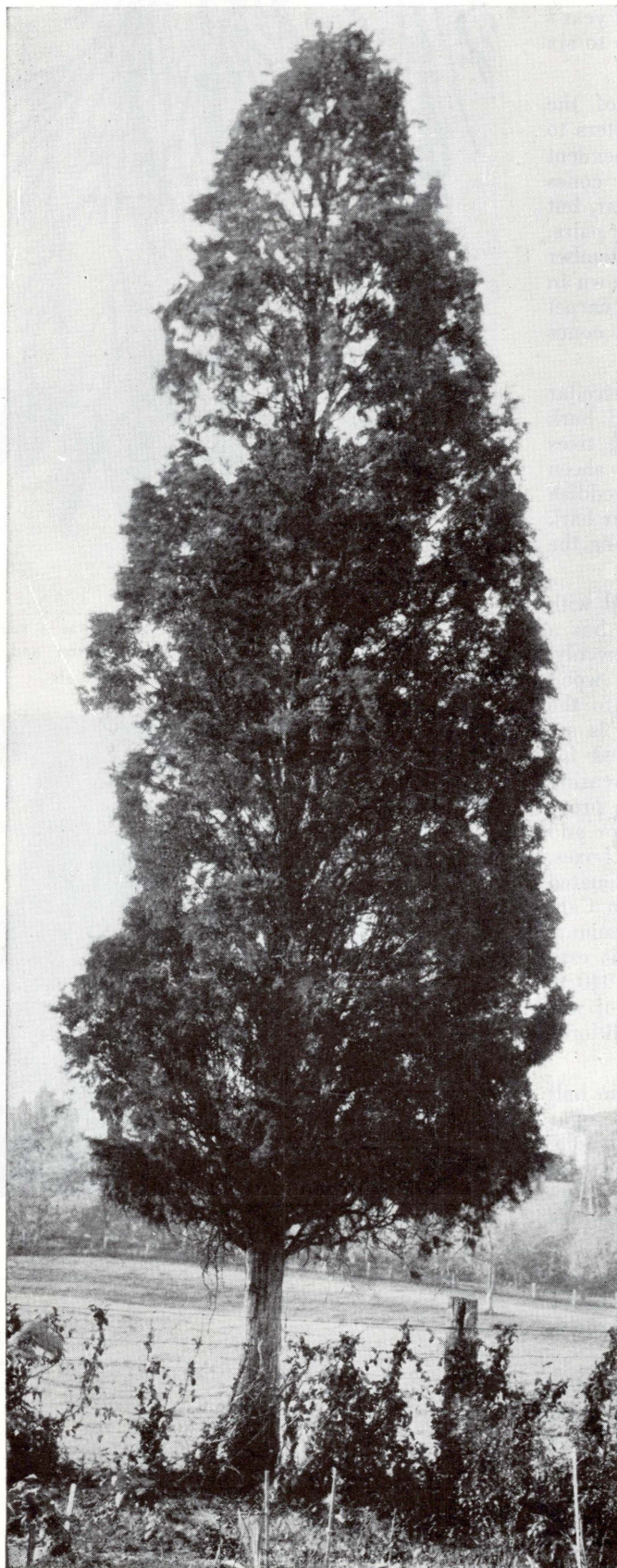
The deeply furrowed, shreddy, cinnamon-red bark is two to three inches thick, or even heavier at the base of old trees



Natural range of California Incensecedar

EASTERN REDCEDAR

Juniperus virginiana, Linnaeus



The slender columnar form of Eastern Redcedar is most frequently seen, but with age the crown becomes broader and more open

FENCE ROWS along pastures and abandoned fields, dry gravelly slopes, rocky ridges, limestone outcroppings, and even swamps and lake borders over most of the eastern half of the country from the Atlantic seaboard to the Great Plains are frequently punctuated with the dense evergreen pyramids or columns of Eastern redcedar.

Ordinarily a tree twenty to fifty feet high with a short trunk one to two feet in diameter, on alluvial soils in the southern states it may attain 120 feet of height and produce a deeply fluted trunk four feet in diameter. On poor soil in the North, redcedar may live for years, becoming scarcely larger than a bush. Growing slowly, trees sixteen inches to two feet in diameter may be 130 to 150 years old, but the larger ones live 300 years or more.

A juniper rather than a true cedar, this *Juniperus* was distinguished by the name *virginiana* because the first botanical specimens were from the Virginia colony. The family is one of great antiquity, and the early forms of some thirty-five known species are found in glacial deposits throughout the world. None occur or were ever found south of the equator. Of the eleven species native to the United States, redcedar is the most widely distributed and most important.

Each tree bears two forms of tiny evergreen leaves. Those on seedlings and vigorous twigs are sharp pointed and awl-shaped, while closely overlapping scale-like ones clothe the major portion of a tree and press hard against the twig in opposite pairs. They remain five or six years on the branches, growing browner with each year.

From February to May small inconspicuous male and female flowers appear on different trees, and occasionally on the same one. From the ovulate bloom a dark blue, fleshy, highly aromatic, berry-like cone develops, with one or two, and rarely three or four tiny chestnut-brown, wingless seeds. By early autumn of the same season that the tree blooms, the green berries mature to a dark purplish blue covered with a white powdery bloom. Not only do these furnish

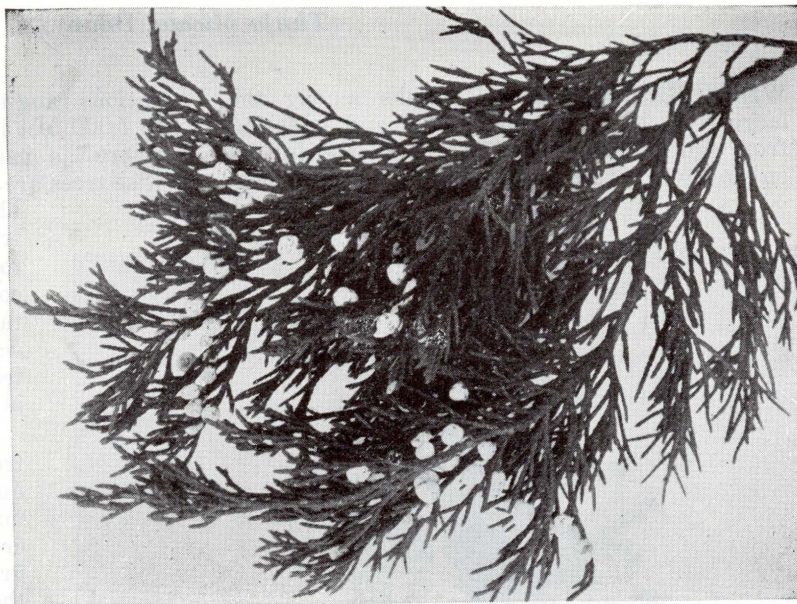
food for birds and small mammals, but they possess medicinal values and are used to flavor gin. Crops of berries are abundant every two or three years, but only one-third to two-thirds of the seeds are capable of germination. Natural reproduction of redcedar is only by seed, which are often scattered by birds.

The shreddy, light reddish brown bark is scarcely more than one-eighth to a quarter of an inch thick. The trunk is often so grooved as to suggest hardship, and the bark peels off in narrow fibrous strips. The reddish bark and wood led the French of Canada to call this cedar *baton rouge*, meaning red stick. Finding the same tree in Louisiana, they gave its name to their capital, Baton Rouge.

The slow-grown, fine-grained, brittle wood of highly aromatic quality is bright pinkish red to deep reddish brown, surrounded by a thin layer of nearly white sapwood. A cubic foot when air dry weighs only thirty-one to thirty-three pounds and because of its soft texture, easy working qualities, fragrance, ability to take a high polish, and durability finds an active demand for lead pencils, lining for clothes chests and closets, cigar boxes, canoes, and a wide variety of wooden-ware. Cedar oil is distilled from the leaves and twigs. The scattering stands prevent any satisfactory estimate of the existing volume of redcedar, and for the same reason the commercial production is largely in the form of small lots of short logs which farmers haul to local markets. A rough estimate places the stand at 325,000,000 board feet. The annual lumber cut is about 13,000,000 board feet, with 17,000,000 additional for fence posts.

A few destructive boring insects feed on living and dead trees and bagworms occasionally eat the foliage. The chief enemy, however, is fire, for the thin bark and shallow root system leaves redcedar an easy victim of relatively light surface fires. In mixture with other trees such as the ashes, maples, oaks, hickories, beech, loblolly pine, black gum, and cypress, it is less seriously affected by fire. Wood rots do considerable damage to southern trees, and as the alternate host of the cedar apple rust it is considered a menace wherever apple growing is of first importance.

Extensively used for ornamental planting, over thirty horticultural forms of redcedar are recognized. It will grow on almost any soil except that which is distinctly swamp.

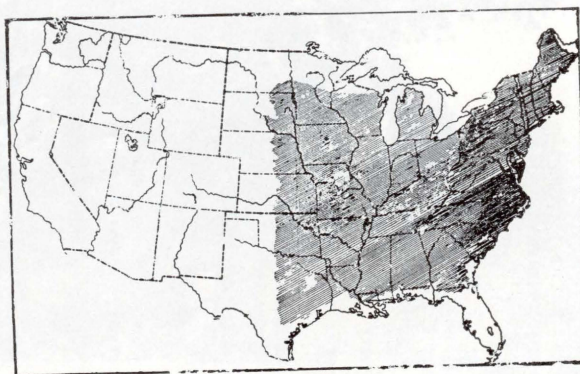


Ernest Crandall

Dark purplish blue berries grow on the sprays of tiny evergreen leaves of Eastern Redcedar



The shreddy, light reddish brown bark is from an eighth to a quarter of an inch thick



Natural range of Eastern Redcedar in the United States

WESTERN REDCEDAR

Thuja plicata, Donn

WESTERN REDCEDAR ranks among the large trees of the Pacific Coast and is found from southern Alaska to northern California, on sites where the soil is moist. It grows at ele-

vations ranging from sea level in the far north to 7,000 feet in the northern Rocky Mountains, where the magnificent proportions of the coast-wise trees are reduced to those of a small wind-blown bush. Heavily buttressed trees 150 to 175 feet high and five to eight feet in diameter are fairly common, while exceptional trees attain heights of 190 to 200 feet with occasional diameters of ten to sixteen feet. The center of large trees is usually hollow.

In densely crowded stands the trees have long clear trunks, frequently with branches below the main crown. The narrow conical crown of young trees reaches to the ground, and even in dense stands the lower branches are retained until the tree reaches heights of fifty to eighty feet. In old trees the crown extends in width, becoming short and blunt. On young trees the slender limbs curve upward, but with age they swing downward in a long graceful curve. While diameters of twenty-four to forty inches are reached in 200 to 500 years, some of the largest trees are believed to be 800 to 1,000 years old.

Small scale-like, bright green leaves form flat, lacy sprays after the manner of the Northern whitecedar, *Thuja occidentalis*. They are glossy above, distinctly darker and with frequent white, triangular spots beneath, remain on the tree about three years, and have a pleasant odor.

Thuja plicata is derived from the Greek and Latin, and refers to a tree having sweet smelling wood whose leaves are plaited or folded.

In April small inconspicuous flowers of the two sexes appear, usually on different branches of the same tree. The flowers are about one-twelfth of an inch long and develop singly at the ends of the twigs. The staminate ones are yellowish and the ovulate are pinkish at pollination. From the latter, leathery brown cones about one-half inch long comprised of six fertile scales, mature by the end of August. Each fertile scale may bear two tiny double-winged



Western Redcedar grows in densely crowded stands to heights of 175 feet and more

Devereux Butcher

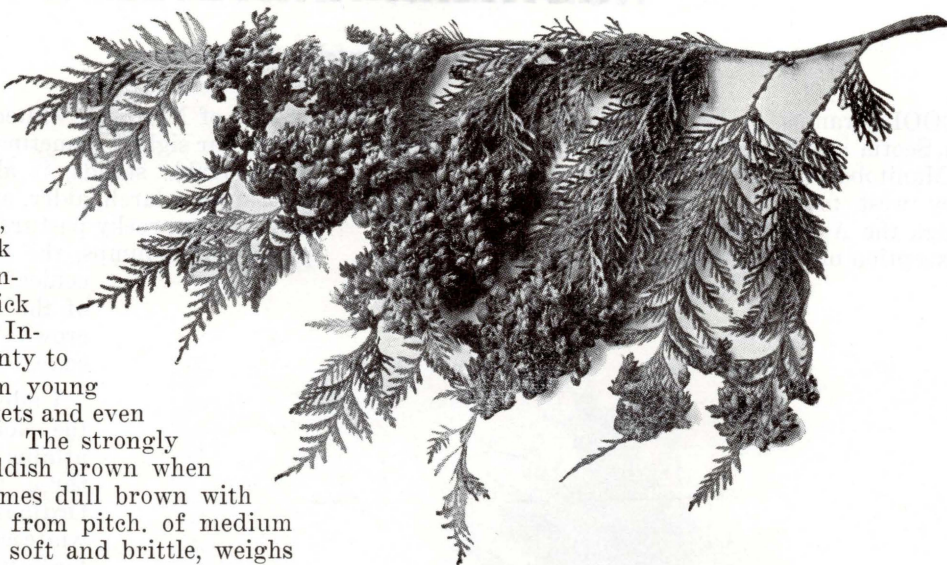
seeds which are shed in the fall of the same year. The upturned empty cones remain on the tree until the following summer. The cinnamon-red, stringy, fibrous bark is seldom over seven-eighths of an inch thick and so tough that the Indians peel strips twenty to thirty feet long from young trees for making baskets and even for rope or fish line. The strongly aromatic wood is reddish brown when freshly cut, but becomes dull brown with exposure. It is free from pitch, of medium to coarse grain, very soft and brittle, weighs twenty-four to thirty pounds to the cubic foot when air dry, and is unusually resistant to decay or insect attack. Over half of all Western redcedar goes into shingles of which it forms the bulk of our supply. Other uses include lumber, poles, posts, piling, boats, pattern stock, laundry machinery, cigar boxes, and greenhouse equipment. Paints, varnishes, and lacquers adhere well and it glues readily. Because it works easily and scarcely warps or shrinks it is favored for the exterior of houses. The Indians of the Pacific Northwest used it for totem poles, canoes, and lodges.

Western redcedar lumber production was about 116,000,000 board feet in 1946. The average annual production for the years 1940 to 1943 was approximately 162,000,000 board feet. The manufacture of shingles consumes about 400,000,000 board feet while an additional 100,000,000 board feet is cut for poles, posts and piling. The annual cut for all purposes is estimated at 760,000,000 board feet. The stand of Western redcedar sawtimber in the United States has been estimated at 33,500,000,000 board feet. Of this amount, about 23,000,000,000 board feet is located in western Washington.

Western redcedar does not grow in pure forests, but forms three to twelve percent of the total growth in company with Douglas-fir and Western hemlock.

The moist character of the sites where Western redcedar grows is an important factor in protecting the tree against fire. The thin bark offers little fire resistance, so that when fires do occur the trees are usually fatally injured. In contrast, however, neither insects nor fungi are major sources of damage.

Although few efforts have been made to use it for reforestation, it is recognized as a conifer of unusual promise for ornamental planting on the West Coast as well as in the eastern states as far north as Massachusetts. It assumes a graceful pyramidal outline and prospers in fertile well drained soil.



Flat, lacy sprays of scale-like, bright green leaves and up-turned leathery brown cones characterize this tree



The cinnamon-red, fibrous bark is less than an inch thick



Natural range of Western Redcedar in the United States

NORTHERN WHITECEDAR

Thuja occidentalis, Linnaeus

IN COOL swamps, or beside streams or lakes from Nova Scotia and New Brunswick west to southeastern Manitoba, and from New England and New Jersey west to central Minnesota and southward through the Appalachian mountains, with the possible exception of Pennsylvania, the narrow, pyramidal

crowns of Northern whitecedar, or arborvitae, make a familiar sight. Sometimes growing in pure, almost impenetrable stands, it also flourishes in company with spruce, larch, alder, and balsam. In moist fields and shallow, rocky pastures, it may grow in scattered picturesque clumps, the taller trees thrusting their conical crowns above the center of the group, while smaller trees crowd close around the outer edge.

Under favorable conditions in the North, this tree occasionally attains seventy feet in height and three to six feet in diameter. Ordinarily, however, Northern whitecedar trees are considered large when fifty to sixty feet tall with diameters of two to three feet. Southward, the tree becomes less abundant and smaller, so that in the mountains of western North Carolina and eastern Tennessee it is found only at high elevations and reduced to the proportions of a shrub.

A slow growing tree, most of its wood is added during early years. It may reach ages of 250 to 300 years.

The smaller twigs and branchlets are so densely covered by scale-like leaves that they appear to be the leaves themselves. Actually, each dark green leaf is scarcely a quarter of an inch long, and with its fellows is arranged in overlapping rows of alternating pairs on the flattened branchlets. The under surface is light green.

In April or May small liver-colored flowers are borne on the ends of the branchlets, the two sexes being separate and distinct from one another. The solitary elongated staminate cones are about one-sixteenth of an inch long, entire, and composed of three to six pairs of stamens, while the purplish ovulate cones are similar in size and consist of four to six pairs of thin, elongated scales. By late summer the fertilized cones mature. They are a light yellow to cinnamon-red, from one-third to one-half inch long and stand erect on the twigs. The seeds which form beneath the scales are light brown, about an eighth of an inch long and nearly encircled by thin wings. These



Northern Whitecedar has a shapely pyramidal crown of feathery dark green foliage

Devereux Butcher

The trunk may be lobed and buttressed at the base, tapering and often divided into two or more secondary stems. It is frequently distorted and twisted; similarly, the thin, fibrous, light brown bark may seem to spiral around the trunk. It is a quarter to a third of an inch thick. On the larger branches the bark is dark orange marked with shallow fissures.

Thuja occidentalis is not a true cedar, but is more strictly speaking an arborvitae. *Thuja* is a Latin name for a conifer tree, while *occidentalis* refers to the fact that it is native to the western hemisphere and thereby distinct from the oriental cedar. American Indians referred to this tree as Oo-soo-ha-tah, meaning, "feather leaf."

This tree begins to bear seed when ten to fifteen years old. Seed producing years follow frequently thereafter. The seed germinate readily and may take root wherever the moist soil is exposed. Because of its trim, somewhat artificial appearance, it is frequently used for hedges and windbreaks. It is also planted for ornamental purposes on lawns and in parks. Nurserymen recognize some forty-five varieties of Northern whitecedar, all of which are propagated by means of cuttings rather than from seed.

Except as protected naturally by its moist environment, it is easily injured by ground fires, but has few serious insect or fungus enemies.



The small scale-like leaves are in overlapping rows on the branchlets. The cones are urn-shaped and grow erect near the ends of the leafy twigs



Range of Northern Whitecedar

DOUGLASFIR

Pseudotsuga taxifolia, Britton

DOUGLASFIR is a widely distributed western tree. It grows naturally throughout the Rocky Mountains, from their eastern base to the Pacific Coast, and northern Mexico and the mountains of western Texas, southern New Mexico and Arizona to British Columbia. It attains its largest size near sea-level in the coast region of southern British Columbia, Washington, Oregon and on the western foothills of the Cascade Mountains. No attempt is made in this description to distinguish between the Oregon variety and the slower growing, more hardy Douglasfir native to Colorado and the interior mountains. It is frequently called red fir, Oregon pine, Douglas spruce, or Douglas yew, but Douglasfir is generally accepted.

Three hundred and twenty-five foot heights have been recorded with trunk diameters of ten to seventeen feet, and are often characterized by a clear shaft for a third of their height. The larger trees may be from four hundred to one thousand years old. The reddish brown bark of large mature trees is broken into oblong longitudinal plates and may be ten to twelve inches thick. The smooth thinner bark of young trees is more of the color of ashes, has resin blisters like the true firs, but thickens as the tree grows larger and becomes reddish brown in color.

The tree is in the nature of a botanical puzzle, for it bears strong resemblance to spruce and fir as well as to the hemlock and yew. Accordingly, the botanists went to the Greek to describe it as a "false hemlock with a yewlike leaf." It was first discovered by Dr. Archibald Menzies in 1791, on the west coast of Vancouver Island; later it was rediscovered by the Scottish traveler David Douglas, who introduced it into England in 1827. Since then it has been widely planted on the British Isles.

The soft, flattened, slightly pointed needles are one-half to one and one-half inches long and grow around the branch so as to give it a full rounded appearance. They are grooved on the upper surface, and have a white band on each side of a prominent midrib beneath. When pulled off they leave an oval scar on top of a little projection. They remain on the trees five to eight years before they fall. Frequently the dark orange-red pointed terminal bud is one-fourth of an inch long, while the side buds are about half as large.

The oval cones are pendulous like those of the spruce and pine. They are an inch and a half to four and one-half inches long and mature in the first autumn from reddish ovulate flowers that grow well out on the ends of the branches. The three-lobed "Neptune's trident" is especially noticeable in the blossom stage. On the same tree are the bright red staminate or male flowers, which appear in the early spring on the under surface of the previous year's growth. The thin, rounded scales of the cone are thrust over conspicuous three-pointed bracts, and under each scale are two seeds, each with a single wing. The parent trees scatter these seed so effectively that they quickly take possession of burned forest areas. Trees may begin producing cones at twelve years of age, and continue with crops nearly every year.

The wood is usually yellowish to light red, with a narrow band of white sapwood. It is fairly light, strong, firm and works well. Compared with other American woods it is the strongest of all in terms of weight. The



Asahel Curtis

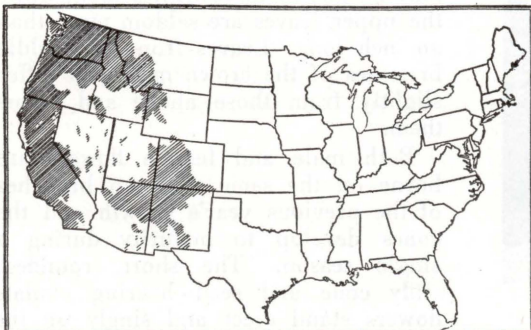
In the mountains of the Pacific Northwest, Douglasfir attains magnificent proportions, sometimes reaching a height of over two hundred feet

immense size of the trees permits the manufacture of timber remarkably free from knots and other defects. It is important in the lumber industry and building trade. When air dry a cubic foot weighs thirty-one pounds. It is used for all kinds of construction, railway ties, piles, etc., is resistant to decay, and can be attractively stained for interior trim. The forests of the United States contain 430,000,000 board feet of Douglasfir sawtimber, nearly three-fourths of which is in western Oregon and western Washington. It is second only to southern pine in volume of lumber production, and the stand comprises about one-fourth of the remaining sawtimber in the country. In 1945, the lumber cut amounted to about 6,237,000,000 board feet. Over one-half of this was produced in Oregon.

Douglasfir may be grown from seed under nursery conditions, and successfully transplanted to forest plantations. Under natural conditions it grows from sea level where more than 100 inches of rain falls each year, to altitudes of nearly 11,000 feet where the annual precipitation is fifteen inches. In deep loam soils it develops wide-spreading root systems. In moist well drained soil trees will grow to a height of thirty-five feet in twenty-five years. The trees prefer northern and western exposures, but will withstand wind fairly well and endure considerable shade. The small trees are hardy and attractive for ornamental planting in the northern and northeastern states as well as in the West. Being moderately tolerant of shade, they hold their branches down to the ground unless heavily shaded.

They may be planted close together and pruned for hedges. The symmetrical young trees whose soft rich green needles hang on long after the tree is cut down are being used in increasing numbers for Christmas trees and holiday decoration.

Douglasfir is particularly subject to fire damage during its early years, but as the bark grows thicker it becomes increasingly resistant. Not only does fire destroy many trees, but it also causes unfavorable soil conditions, and the fire scars furnish places where insects and fungi may enter. It may be attacked by a long list of insects, fungi and mistletoe but is little affected by most of them. The worst insect enemy is a beetle which bores between the bark and the wood, frequently killing the tree. Periodically the western hemlock looper destroys considerable merchantable timber, and eastern plantations have been threatened by a larch canker, but taken as a whole such losses are comparatively small.



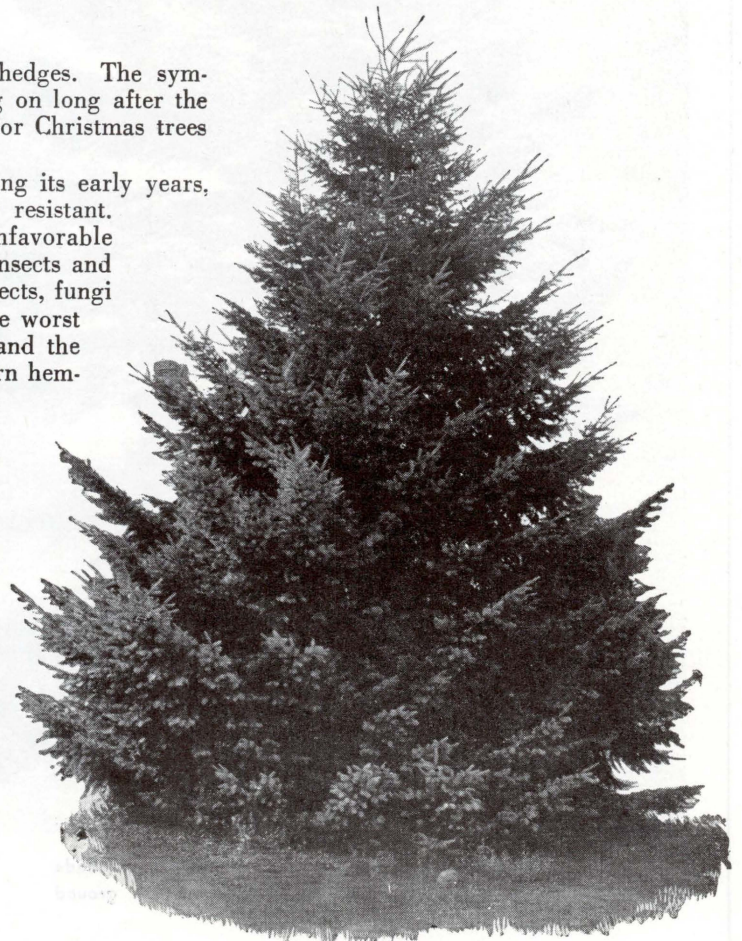
Natural range of Douglasfir in the United States



The reddish brown deeply fissured bark of mature trees is sometimes a foot thick



Above:—The three-pointed bracts extending beyond the cone scales, the flexible, bluntly pointed green needles, and dark orange-red winter buds help identify Douglasfir



Below:—When young, Douglasfirs are dense-foliaged and symmetrical. They are planted over a wide area to decorate home grounds, for wind-breaks and for future stands of timber

WHITE FIR

Abies concolor, Parry

WHITE FIR is the most important of seven true firs inhabiting the forests of the Pacific slope and of the Rocky Mountains. It grows generally on north slopes at moderate altitudes from southern Oregon through California into Lower Cali-

fornia, and from Nevada, Utah and southern Colorado through Arizona and New Mexico. It reaches greatest growth in northern California on the north and east slopes and at the heads of streams. While thriving best on fairly deep, rich, moist loams, white fir does well on all moderately moist soils, except heavy clays, and frequently grows on dry, coarse, disintegrated granite. It is a massive tree whose dense, heavily-foliaged crown may extend to the ground in open-grown trees or from a third to a half the way down the straight, ashy gray, gradually tapering trunk of forest-grown trees. The lower and middle crown branches droop conspicuously, while the upper branches are upright. With great age, growth slows down and the trees develop a rounded top. Occasional trees grow to a height of two hundred feet and measure six feet or more in diameter. Such trees may be three hundred and fifty years old, but trees forty inches in diameter are considered large.

Young trees have comparatively smooth, ashy gray bark with a brownish tinge, whose conspicuous resin blisters like those of the other true firs give rise to the popular name, "balsam." This clear material has several medicinal and scientific uses. With age the bark thickens to four or six inches, takes on a distinctly ashy gray color, breaks into deep, longitudinal furrows, and becomes hard, horny and fire resistant.

The flat, plump, blunt-pointed leaves form a yellow-green foliage with a bluish cast in the first few months of growth. With maturity this becomes more pale and takes on a whitish cast, which, with the light-colored bark, gives rise to the name, white fir. The leaves are arranged spirally on the branches and remain five to ten years before dropping. They stand out distinctly from two sides of the branch and those on the lower part of the tree are frequently longer, less curved and more sparse than those on the upper branches. Leaves of lower branches may be one to three inches long, while the upper leaves are seldom more than an inch long. Leaves from the middle branches of the crown may also differ slightly from those above and below them.

Both male and female flowers are borne on the same trees on branches of the previous year's growth and the cones develop to maturity during a single season. The short, rounded, scaly cone and seed-bearing ovulate flowers stand erect and singly on the uppermost branches of the crown. Be-



White Fir is a massive tree, is tolerant of shade and frequently holds its branches to the ground

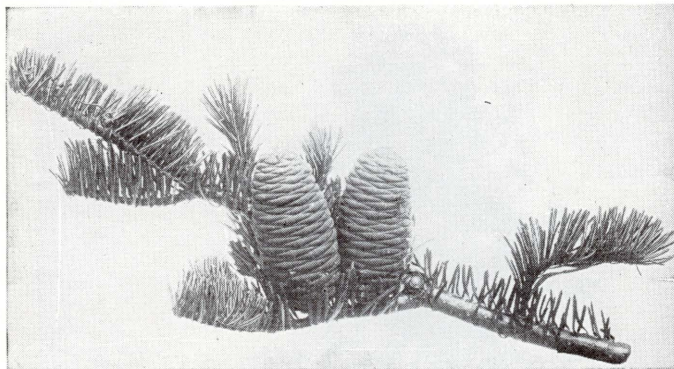
low them, from the underside of the lower branches, hang the elongated, scaly, pollen-bearing, staminate flowers which drop soon after releasing their pollen. The cones, like those of other true firs, maintain an erect position and in early September mature as close-packed cylinders of cone scales, three to five inches long and range in color from ashen-tinged olive-green to purple. The seeds, which develop at the base of the scales, are a dingy yellow-brown with shiny, clear, rose-tinged wings. They are released to be carried fifty to one hundred feet by the wind as the thin, close-packed, overlapping cone scales gradually fall away from the central spike-like axis. Good seed crops occur at irregular intervals of two or three years, and, while most abundant during rapid height growth, continue to maturity. The erect, woody spikes of the cones remain attached to the branches for several years. In no cone-bearing trees except the eastern baldcypress does the cone break up as does that of the firs.

White fir wood is white, straight-grained, and fine-textured. It has no resin ducts and only a slight distinction between sapwood and heartwood. Unseasoned lumber has a disagreeable odor which is so entirely lost with seasoning that it has been successfully used for butter tubs. Its slight resistance to decay makes treatment necessary wherever the wood is to be used in contact with the soil or where termites are prevalent. The wood weighs about twenty-six pounds to the cubic foot when air dry, or 1,550 to 1,600 pounds for every thousand board feet of sawed lumber. It compares favorably with eastern hemlock, spruce and ponderosa pine in strength and is used largely for the construction of small houses and for boxes and crates. It holds paint well and is successfully used for cupboards and interior trim. Pulp material suitable for newspaper and wrapping paper can be produced, but there is small prospect of any immediate market within its range.

The lumber of white fir is comparatively little known in lumber markets and is sold with that of grand fir (*Abies grandis*), red fir (*Abies magnifica*) and the other true firs. The lumber trade makes little effort to distinguish one from the other. The stand of all the western true firs is estimated at 113,541,000,000 board feet, more than one-third of which is white fir, about seventy percent of it in California. In 1946, the lumber cut of all western true firs was 491,900,000 board feet—the largest so far reported. California supplies nearly one-half of the total.

While the seeds have a relatively low percentage of germination, they grow readily on almost any seed bed. The tree reproduces naturally on exposed denuded lands as well as under its own shade. The seeds will grow under cultivation and the small trees are readily transplanted.

White fir is widely used as an ornamental tree, and is growing successfully in many eastern states from Virginia north into New England. Its dense symmetrical crown and ability to survive under heavy shade render it especially suitable for landscape planting.



The mature cone is three to five inches long and stands erect on the topmost branches



With age the resin pockets, or "balsam blisters," disappear and the ashy gray bark becomes deeply furrowed, hard, horny, and fire-resistant



Natural range of White Fir in the United States

EASTERN HEMLOCK

Tsuga canadensis, (Linnaeus) Carriere



EASTERN hemlock with its irregular crown of dark green foliage, its slender gracefully drooping leader, and its massive trunk is a feature of the forest and open country on cool, moist slopes and in well drained, fertile valleys throughout the northeastern states from northern Maine to northeastern Minnesota, south through Wisconsin, southern Michigan and Indiana, and southward along the mountains from Pennsylvania and West Virginia into northern Alabama and Georgia.

Of relatively slow growth, it reaches maturity in 250 to 300 years and often lives for 600 years or more. While many trees are sixty to eighty feet high and two to three feet in diameter, heights of over 100 feet and diameters exceeding four feet are not uncommon. Occasional individuals 160 feet high and six feet in diameter have been measured.

The flat narrow leaves are one-third to two-thirds of an inch long, rounded or minutely notched at the end, shiny dark green above, light green below, and marked with two parallel white lines of white dots or stomata beneath. Each leaf or needle grows on a thread-like stem or petiole, and while borne spirally on the branchlets they appear to be two-ranked, like a flat spray. The early spring foliage is a delicate light yellow-green contrasting with the darker green of previous years. The needles remain on the twigs for three or more years, and upon falling, the base of the petiole remains, giving the twig a roughened appearance.

Early in May each tree bears separate male and female flowers on twigs of the previous year. The small, yellow, globular male blossoms appear singly in the axils of the previous season's leaves and occasionally near the ends of the twigs, while the small seed-bearing female flowers are erect and greenish, with circular scales from the upper surface of which may appear thin bracts. Blossoms appear on all parts of a tree, from the top to the lowest branches. By October at the end of one season the fertilized ovulate flowers develop into broadly oval, green to purple cones, one-half to one inch long which become reddish brown and hang down singly from short stalks as they reach maturity. These are among the smallest of all tree cones. Under each fertile scale are two light brown seeds whose transparent wings help carry them on the wind. The partially empty cones remain on the twigs through the fall and much of the winter. A single seed is about one-sixteenth of an inch long, and 400,000 are in a pound. In spite of the many seeds produced each year, hemlock reproduces poorly. Seedlings cannot endure strong light and reproduction is best in moist,

Hemlock reveals its rugged beauty and massive proportions when growing in the open or near the edge of a forest. Trees may attain heights of seventy-five to 160 feet and diameters of two to four feet or more

shady places. Later when the roots have developed they respond to increased light with more vigorous growth.

The tiny, reddish brown buds are alternate and the slender, yellowish brown twigs are coated with fine hairs in the first winter, but later become smooth and dark gray or purplish brown. The branching is irregular rather than in whorls as with the pines and firs.

Deeply divided cinnamon-red to brown bark covers the rapidly tapering trunks of mature trees. It is from two to three inches thick, broadly ridged, and covered with fine scales. The bark may comprise fifteen to nineteen percent of the cubic volume of a tree. The value of the tannin was for years so great in comparison with the lumber that great trees were frequently left to decay in the forest after the bark had been removed. The bark is peeled off in rectangular sheets about four feet square and is still so greatly in demand by the leather industry that lumbering operations are usually confined to the spring and summer when it "slips" easily. From 70,000 to 130,000 tons of bark are produced each year.

With scarcity of other lumber, the light buff, soft, coarse-grained wood of hemlock has become of increasing importance. It weighs only 28 pounds to the cubic foot when air dry, is practically without taste or odor, is not durable when exposed to the elements, and is frequently splintery and subject to windshake. The lumber is used for boxing, crating, general construction, and railroad ties, and recently as a source of chemical pulp for the manufacture of paper. Hemlock possesses unusual power to hold nails and spikes. It is low in fuel value.

With an estimated stand of 15,000,000,000 board feet, the bulk of the cut for 1946 amounting to 691,000,000 board feet came from Wisconsin, Michigan, Maine, Pennsylvania, West Virginia, New Hampshire, and New York. Until about 1928 the normal annual production was shown to exceed 750,000,000 board feet. In the North the common associates of hemlock are white pine, beech, yellow birch, and the maples, while in the southern mountains it grows with tuliptrees, red maple, the hickories, oaks, and chestnut. Hemlock stands have yielded 25,000 board feet to the acre, but 15,000 to 20,000 board feet is more common. Individual trees frequently yield 1,500 board feet of lumber.

Hemlock is a member of the pine family and is of ancient origin. Remains of leaves, cones and wood have been found in early geological strata of America and Asia. Of the nine known species four are found on this continent, two being native to the eastern states and two to the northwestern mountains. The others are in Japan, China, and the Himalayan Mountains between India and Tibet. There are no native hemlocks in Europe. The name *Tsuga* was first applied to the genus in 1847 by the dendrologist, Stephen L. Endlicher, and is a Japanese word meaning yew-leaved, while *canadensis* means Canadian, although the tree is so common south of the international boundary as to be ranked among the important sources of timber in the United States. Since June 22, 1931, it has been Pennsylvania's state tree.

Few insect and fungus pests are of importance in the life of the eastern hemlock and they seldom occur in serious epidemic. Next to ground fires which may burn through the deep humus and kill the trees, and severe winds which may tip them over, the most destructive enemy is the flat-headed eastern hemlock borer.

Hemlock ranks high among all coniferous evergreens for ornamental planting, and in its juvenile stages it lends itself to border and background plantings.

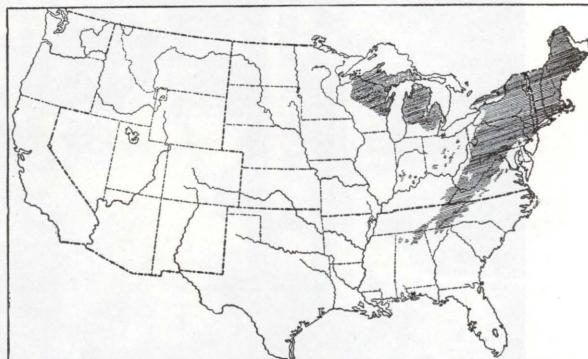


George J. Baetzhold

The two-ranked sprays of narrow, flat, round-tipped needles are dark green on the upper surface and light green beneath. The cones are a quarter to a half inch long and begin shedding their seeds in the early fall



The cinnamon-red bark, broken into broad ridges by long, longitudinal fissures, may be two to three inches thick and is an important source of tannin



Natural range of Eastern Hemlock in the United States



Tsuga heterophylla, (Rafinesque) Sargent

WESTERN hemlock, a tree of increasing economic importance, is found in the deep forests of the humid coast regions from Prince William Sound in Alaska for a thousand miles to Marin County, California, just north of San Francisco, and inland as far as northern Idaho and northwestern Montana. It grows best in cool, moist locations on the seaward side of the Cascade Mountains, at elevations from 1,500 to 3,500 feet above sea level, but ascends from sea level to altitudes of 6,000 feet.

Growing to greater dimensions than its eastern relatives, this tree under favorable conditions may become 130 to 150 feet high and from seventeen to twenty-one inches in diameter in one hundred years. Occasionally, western hemlock reaches an age of 500 years or more, when it develops to heights of 175 to 250 feet with diameters ranging to eight or ten feet.

Everywhere it is a dignified tree, with grave and massive outline, but in the dense forest the crown of irregular, slender, pendulous branches is narrow and pyramidal. The long, clean, cylindrical trunk has little taper, and the base is often suddenly buttressed. Open-grown trees have a broad crown which may extend to the base of the trunk. Being tolerant of shade, it clears its trunk of branches somewhat slowly.

The flat, narrow, distinctly grooved leaves are a dark, highly lustrous green from one-third to three-fourths of an inch long. They remain on the branchlets three to six years. Closely resembling the leaves of eastern hemlock, the ends are distinctly rounded and the two bands of white stomata on the under side of each leaf are less well defined. *Tsuga* is the Japanese name for hemlock, while *heterophylla* is derived from two Greek words meaning other or different leaves. Apparently it was applied by Rafinesque in an effort to indicate the slight distinguishing differences of the leaf from that of *Tsuga canadensis*, the eastern hemlock.

Male and female blossoms are borne separately on sprays of the preceding season, on different parts of the same tree. Yellow, pollen-bearing, male flowers grow singly at the base of leaves near the ends of the branchlets, while the small, purple, scaly female flowers are at the ends of the sprays.

By the middle or end of August, the reddish clay-brown cones which develop from the pistillate blossoms are mature and ready to discharge their winged seeds. These cones hang from the ends of the branchlets, are nearly twice the size of those of eastern hem-

Western Hemlock, largest of eight hemlock species, attains heights of 150 to 250 feet, and diameters up to eight or ten feet

lock, being three-fourths to one and one-fourth inches long, and are more acutely pointed. Each cone is attached by a short thread-like stem, and drops during the succeeding winter. The thin, overlapping scales are faintly downy on the outer surface. Under each scale may be two light brown seeds, about one-eighth of an inch long, whose ample wing carries them considerable distances on the wind.

Open grown trees begin to bear seed when twenty-five to thirty years old, but those growing in dense forests at a much older age. Some seed are produced nearly every year, but heavy crops occur at intervals of two or three years. The seed, which are borne in large amounts, are fairly high in germinative ability, retain their vitality for several years, and develop best on wet moss, decaying wood or moist humus. This tree reproduces freely under a variety of conditions, and while the seedlings can endure dense shade, they grow more rapidly in the sunlight.

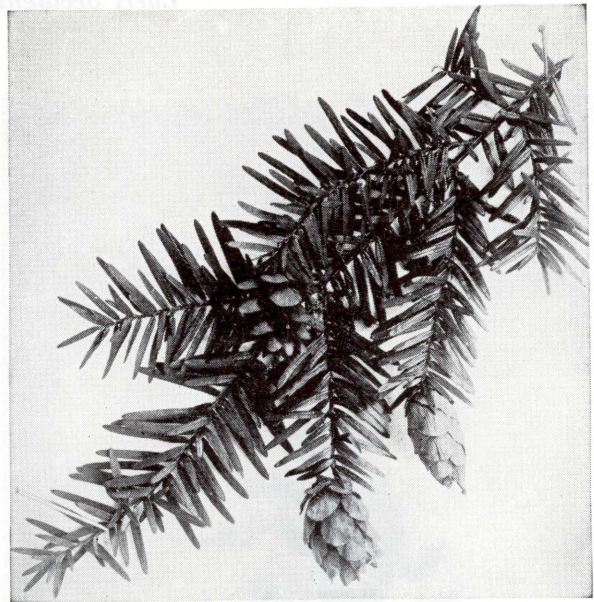
On old trunks the dark russet-brown, deeply furrowed bark may be one and one-half inches thick. It is even richer in tannin than that of eastern hemlock, having twelve to fifteen percent, as compared with ten to thirteen percent for the eastern variety.

The pale, yellowish brown heartwood contrasts with the narrow area of white sapwood, and weighs about twenty-nine pounds to the cubic foot when air dry. It is heavier, harder, and stronger than the wood of eastern hemlock, is less splintery, and because of its soft, fine, non-resinous texture and straight grain is finding an increasing demand in commerce. The wood is relatively resistant to attacks by termites, but is not durable when used untreated under conditions that favor decay. When commercially dry it is suitable for all but the heaviest construction work, and is extensively used for framing material, house sheathing, planing mill products, boxes, barrels, railroad ties, concrete forms, and is rapidly becoming one of the most important pulp woods grown on this continent.

The total stand of western hemlock in the United States is estimated to be 97,207,000,000 board feet, nearly all of which is in western Washington and Oregon. In addition, about 60,000,000,000 board feet is in Alaska. In 1944 the cut was 730,000,000 board feet, of which 578,000,000 came from Washington. The peak of western hemlock production was reached in 1928 when 1,549,000,000 board feet was cut.

The comparatively thin bark and shallow root system make it highly susceptible to fire injury and to windfall. While less frequently damaged by "wind shake" than the eastern hemlock, it suffers heavily from insects and fungi, against which little can be done.

Its ability to withstand shade makes it desirable for ornamental purposes, but it does not thrive in the central and eastern states.



Round-tipped, flat, glossy green leaves, and narrowly pointed, pendent cones are three-fourths of an inch to an inch and a quarter long



The deeply furrowed russet-brown bark is over an inch thick and rich in tannin



The natural range of Western Hemlock extends along the Pacific Coast into Alaska

WESTERN LARCH

Larix occidentalis, Nuttall



Western Larch attains heights of over two hundred feet and develops a slender symmetrical crown covered with satiny, pale green foliage

THE most important, as well as the largest and most massive of all the larches or tamaracks is Western larch, whose natural range is restricted to the high mountain valleys and slopes of southeastern British Columbia and the upper Columbia River basin bounded by the Rocky Mountains on the east and the Cascade Mountains on the west. This tree is seldom found below 2,000 feet or higher than 7,000 feet above sea level, and attains its greatest size and abundance in Montana.

Short, horizontal branches on a tall straight trunk form a crown whose narrow, pyramidal form runs to a slender point. The crown usually occupies from one-half to one-third of the total height, so that trees 160 to 200 feet tall may have sixty to over one hundred feet of clear trunk. Such individuals which occasionally attain diameters of six or seven feet, may be 600 or 700 years old, while trees sixteen to twenty inches in diameter may be 250 to 400 years old.

The larches and the southern cypress are unique among coniferous trees in that they shed their leaves in the autumn. The light green, flatly triangular pointed needles are one to one and five-eighths inches long. First appearing singly in spirals on the twig, they later develop on a scaly spur in bundles of thirty to forty. They turn yellow in the fall and drop, but new ones develop on the same spur for several years thereafter. The foliage is sparse, and gives the crown a pale green, satiny appearance.

Separate male and female flowers are borne close together on the same tree during the early spring on growth of the previous year. The yellow-green, pollen-bearing male flowers are about the size of a pea, while developing on the same twigs are small scaly, bright purple or red ovulate flowers, each of which is surrounded by a bundle of leaves. These flowers, when fertilized, develop into broadly egg-shaped cones, one to one and a half inches long, with slender bracts which extend beyond the cone scales. In the early fall the small, chestnut-brown, winged seeds are shed, and by the end of October or November the cones have dropped from the trees. Cones are seldom produced on trees younger than twenty-five years old, and heavy crops are not produced until the trees are forty years or older.

The conspicuous bract extending beyond the cone scale, as in the case of Douglasfir cones, the white woolly coating of hairs near the base of the cone, their larger size, and the fine hairy growth on the young twigs help distinguish Western larch from the other larches. The leaves or needles are triangular in cross-section and longer, and the tree attains the greatest size of all the larches.

Mature trees have deeply furrowed dull, reddish cinnamon-brown bark composed of innumerable overlapping rounded plates broken to form a zig-zag pattern of many imperfect diamonds. It is three to six inches thick near the base. Higher up on the trunk and on the branches, the bark is relatively thin, scaly and more brown than red. The thick bark on the lower trunk often proves an effective protection against fire. This, together with the natural tolerance of the tree, helps explain the pure stands of Western larch which frequently follow the destruction of lodgepole pine and other associates

by fire. The hard, fine-grained, reddish brown wood is not only the heaviest of all the larches, but one of the heaviest of all the conifers. It weighs thirty-six to thirty-nine pounds to the cubic foot when air dry, and is remarkably durable in contact with the soil. It works well with tools and is used to an increasing extent for interior finish, boxes, boats, and furniture, as well as for telephone poles, railroad ties, mine timbers, and posts. Its largest use is probably as rough lumber in local construction. The butt logs, however, are so heavy, and frequently so full of defects that they are often left in the woods. Pulping experiments indicate that Western larch is suitable for the production of high-grade wrapping paper.

With an estimated stand of 26,606,000,000 board feet of Western larch sawtimber, most of which is in the national forests, the lumber production in 1945 was reported as 190,722,000 board feet. Over one-half of the cut comes from the forests of Montana and the remainder from Idaho, Washington and Oregon. The high point in the production of Western larch was in 1920 when the cut was 338,700,000 board feet. During the twenty years from 1911 to 1930, the average annual lumber cut was 275,000,000 board feet.

Western larch sometimes occurs in pure open forests, but is usually associated with other species. In mixture with ponderosa pine, in eastern Oregon, stands of about 2,000 board feet an acre are common, while in western Montana in mixture with Western white pine, Douglasfir, lodgepole pine, lowland white fir, alpine fir, and Engelmann spruce the stand may reach 10,000 to 12,000 board feet to the acre.

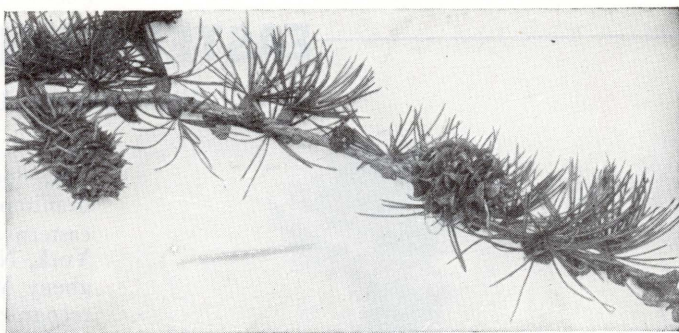
Throughout its range the natural reproduction is increased by fires, because the seedlings require a large amount of light, and because of the relative resistance which large trees have to fire. In this respect Western larch finds lodgepole pine its chief competitor. Favorite areas for pure larch reproduction are those so thoroughly burned over as practically to prevent any immediate heavy reproduction of lodgepole pine.

The precipitation throughout much of its range is from twenty to thirty inches, with long seasons of moderately heavy snowfall, frequent rains in the spring and fall, but hot dry summers.

While relatively resistant to fire, Western larch is subject to the attack of a number of wood-destroying fungi, the most common of which is a chalky, quinine fungus which causes a brown heart rot. It is also subject to what the lumbermen call "shake"—a breaking or disintegration along the growth rings of the lower trunk.

There is evidence that the larches have existed for millions of years in the north temperate and subarctic zones of North America and Europe. Of the nine species inhabiting the world four are native to this continent. In addition to Western larch, there is the Eastern tamarack common to the northeastern states and extending westward to southern Alaska, alpine larch found in the high mountains of the Northwest, and Alaska larch limited to a portion of that territory.

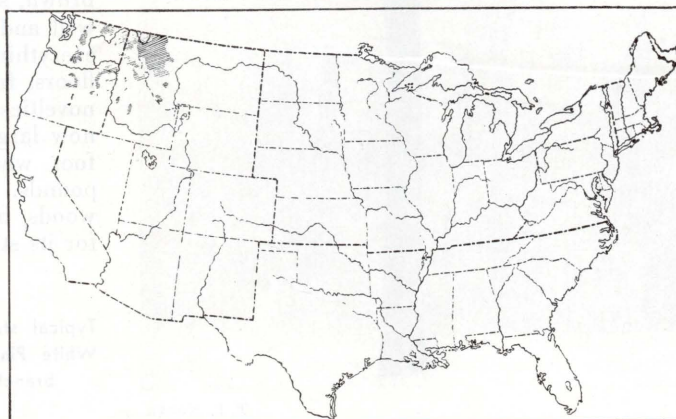
Larix occidentalis may be translated directly to mean the larch of the western world. David Douglas first observed and described it in April, 1826, in northwestern Washington near Kettle Falls on the Columbia River.



Elongated cones one to one and five-eighths inches long grow on the branches along with the clusters of thirty to forty fine, flexible needles



The dull cinnamon-brown bark, composed of many small irregularly rounded plates, may be three to six inches thick near the base of the trunk



Natural range of Western Larch in the United States

EASTERN WHITE PINE

Pinus strobus, Linnaeus



T. F. Kouba

WHITE PINE, long known as monarch of the eastern forests, flourishes from Newfoundland to Lake Winnipeg in Manitoba, southward through eastern Minnesota, to south-eastern Iowa, and east through Wisconsin, Michigan, New York, New England and Pennsylvania, and along the Allegheny Mountains to northern Georgia. European foresters recognize it as Weymouth pine for Lord Weymouth, who planted it more than two hundred years ago on his English estate.

The sturdy, gradually tapering trunk and the horizontal limbs of the blue-green crown of white pine are a characteristic feature of many northern forests, where trees with trunks six feet in diameter and crowns reaching to a height of 250 feet were reported by the early lumbermen. Next to the sugar pine of California, Eastern white pine is the largest pine growing in the United States.

The blue-green needles, three to five inches long, are always borne in bunches of five, and remain on the tree from three to five years. A loose, papery, brown sheath surrounds their base during the spring and early summer. In May and June yellow staminate cone-like blossoms appear on the new shoots of the lower branches and produce quantities of pollen, which is borne great distances by the wind. At the same time, small bright pink cone-bearing ovulate flowers with purple scale margins occur on the end of the upper young shoots. The staminate blossoms wither and fall soon after they have lost their pollen, but by the end of the first season's growth the tiny upright, green cones are about an inch long. Early in the second season these elongate, turn down with increasing weight, and grow to a length of five to eleven inches before turning brown and maturing in August. In September the cone opens and winged seeds are discharged to be carried as far as a quarter of a mile by the wind. The scientific name *strobus* probably refers to the conspicuous cone, being derived from Greek and Latin words for pine cone.

On the branches and young trunks white pine bark is thin, smooth and greenish brown, but with increasing age it becomes fissured, ridged, darker and heavier, until it may vary from less than an inch to four inches in thickness according to the age and exposure.

During the first few years white pine develops a moderately long tap root with spreading lateral roots. This helps to make young trees easy to transplant. As the tree matures the lateral roots develop more vigorously than the tap root, resulting in a shallow root system similar to that of spruce.

White pine lumber ranks among the principal economic woods of North America. It is creamy white to reddish brown, soft, straight-grained, may be cut with ease, polishes well and when seasoned warps or swells but little. Almost everything from ships' masts to matches, including doors, floors, framing, finish, patterns, models, boxes, crating and novelties have been made of this versatile wood, but it is now largely restricted to the more exacting uses. A cubic foot when air dry weighs twenty-four to twenty-seven pounds. It is probably the least resinous of all the pine woods, but has a mildly resinous odor. Although not noted for its strength, it compares favorably with ponderosa pine,

Typical straight trunk of a forest-grown Eastern White Pine. The whorls of the tree's horizontal branches form a narrow irregular crown

cottonwood and basswood. In 1946 the total lumber production of Eastern white pine was about 1,500,000,000 board feet. The total commercial stand in the United States, including a small amount of red pine, is estimated to be 15,000,000,000 board feet, about three-fourths of which is in New England and the Lake States. The original stand in the United States and Canada was approximately 750,000,000,000 board feet, of which 600,000,000,000 was in the United States. King of American commercial woods before the present century, it is now exceeded in quantity of lumber produced by the southern pines as a group, Douglasfir, the oaks and ponderosa pine.

White pine thrives on deep sandy loams, but will grow under a variety of soil conditions where adequate moisture is available. It grows in nearly pure stands and in mixture with hardwoods, as well as with hemlock and red pine. White pine of the original forests grew to be two hundred to two hundred and fifty years old, with occasional trees of three hundred to three hundred and fifty years. Under modern economic conditions, however, trees are usually cut at sixty to eighty years when they measure from twelve to seventeen inches in diameter and are from eighty to one hundred feet tall. Such stands may contain from 50,000 to 80,000 board feet to the acre. In the original forests, trees from thirty to forty inches in diameter required at least two hundred and forty years to grow. White pine reproduces readily from seed, and with fair soil, sunlight and moisture, will reach heights of ten feet in ten years, twenty-five feet in twenty years, sixty feet in forty years, thus averaging fifteen to eighteen inches each year. Similar trees forty years old may measure from seven to nine inches in diameter and yield fifty to eighty board feet of merchantable material. It is the most rapid growing northern forest tree, occasionally averaging a yearly growth of one thousand board feet an acre over periods of forty to eighty years. It responds to silvicultural treatment and has been more widely planted than any other American tree.

Fire, white pine blister rust and white pine weevil are the white pine's principal enemies, although other pests such as white pine scale, the pine sawyer and several root fungi and rots cause heavy damage. Forest fires are particularly damaging to the young growth. Fire is an enemy common to all trees, but white pine blister rust, which entered this country from Europe about thirty years ago, is peculiar to the five-needled pines and takes a heavy toll. This can be controlled by destroying all gooseberry and currant bushes, which are intermediate hosts of the disease, in the forest and for a distance of nine hundred feet from the trees to be protected. Without the leaves of these plants the disease can neither complete its life cycle nor infect other white pines.

Throughout portions of its range the leader shoots of white pine are killed by the white pine weevil. The tree is not killed, but frequently is so deformed as to make it valueless for lumber. No satisfactory control of the weevil has been developed.

White pine is seldom used for street or roadside purposes, but its vigorous growth and attractive color cause it to be favored as an ornamental tree for lawn and park purposes as well as for a background for other plantings. It is successfully grown considerably beyond its natural range, and has long been planted in northern Europe.



Long tapering cones, slender bluish green needles in bunches of five, and clusters of yellow pollen-bearing blossoms



Broad, flat-topped, dark gray longitudinal ridges characterize Eastern White Pine bark



Natural range of Eastern White Pine in the United States

LOBLOLLY PINE

Pinus taeda, Linnaeus

LOBLOLLY pine is one of the four important Southern yellow pines. Frequently known as "old field pine," it extends over the coastal plain and lower Piedmont sections from southern Delaware, south and west into the river valleys of eastern Texas and southern Arkansas. It often grows



Loblolly Pine usually grows on flat moist land and develops a clean, straight trunk and broad open crown

in moist depressions locally called "loblollies" — hence the name, loblolly pine. The tall, straight, cinnamon colored trunk supports a relatively short, open, spreading crown. Trees have attained a height of 170 feet with a breast-high diameter of six feet while trees ninety to 120 feet high and three to four feet in diameter are not uncommon. The trunk may be sixty to eighty feet to the first limb. Trees occasionally reach an age of 150 years, although few trees live over one hundred years. The lower limbs of the crown spread horizontally and droop at the outer ends while those in the upper portions of the tree are more erect.

The red-brown to cinnamon colored bark is deeply furrowed into broad, flat oblong plates made up of many thin, closely pressed scales, and is usually from three-quarters of an inch to one and one-half inches thick. The slender brown twigs have a tinge of yellow and may be distinguished from other three-needled pines by a fine bloom or fuzz during their first season. The pale green needles are five to nine inches long, are borne in threes, held together at the base by a fibrous sheath, and stay on the twig for three or four years. They are slender, stiff, slightly twisted and tipped with a rigid sharp point. The buds are without resin.

From the middle of March to the first of April yellow pollen-bearing staminate flowers appear crowded at the base of the lower twigs, while higher up in the trees are single or occasionally clustered yellow ovulate flowers. At the end of the second season these mature into light reddish brown, broad, more or less egg-shaped cones three to six inches long. Each woody cone scale is tipped with a stout triangular spine.

Blackish, winged seeds are discharged from October to late November of the second season, but the cones hang on the trees for months before they break off leaving a short stock. The seeds are carried considerable distances by the wind and usually germinate the following spring. They grow best on exposed mineral soil such as abandoned agricultural land. Accordingly, the tree is called "old field pine." Open grown trees may seed abundantly when twenty to thirty years old and the seeds are highly fertile. Loblolly pine is essentially moisture-loving and reaches its best growth where the water table is close to the surface of the ground, or where the soil is able to hold moisture during the growing season.

The light brown, coarse-grained wood is resinous and, while lighter and softer than the wood of longleaf pine, is nearly as strong. It weighs about thirty-four to thirty-eight pounds to the cubic foot when air dry and is used for construction, interior finish, bridges, freight cars, barrel shoos, boxes, crating and tobacco hogsheads. When treated with creosote to prevent decay, it is used for railroad ties and piling. More recently it has been successfully used in the manufacture of paper.

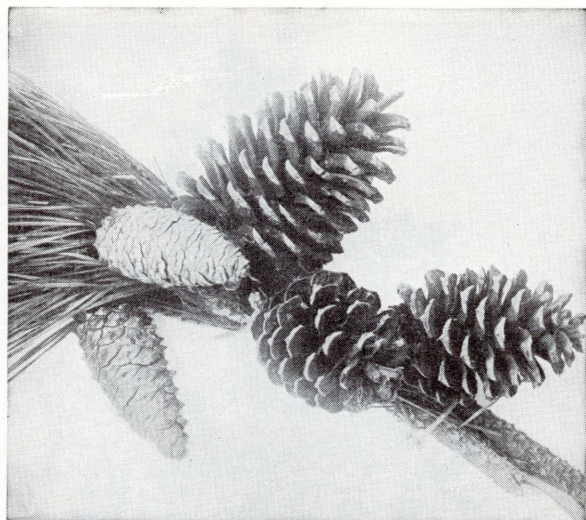
Loblolly is the most plentiful of the southern pines and makes up a large part of the cut of "southern yellow pine" which totaled 9,500,000,000 board feet in 1946. The estimated stand of all southern pines in 1945 was 188,327,000,000 board feet. About 127,000,000,000 board feet is in the Deep South, of which probably one-half is loblolly, largely in Georgia, Alabama and Texas.

Because loblolly pine has a thick bark and grows largely on low sites or in damp soils it is relatively

resistant to fire. Heavy losses frequently occur, however, on higher land and in no case is it benefited by fire. It is also subject to attacks from the ravages of the pine sawyer and the Southern pine bark beetle, and a bud moth which destroys the terminal shoots of young pines. The first two insects are small beetles which bore in the bark and cambium. Insect attacks may be controlled by cutting all infested trees as soon as the foliage begins to brown. While the logs may be used, the bark and branches should be burned as quickly as possible. Similarly, when trees are cut from May to October the logs should be peeled and the bark burned along with any limbs or fresh woody trash.

Loblolly pine grows faster over long periods than any other Southern pine. In fairly open stands, with ample space for the branches and roots of each tree to spread, they may attain diameters of nine to fourteen inches and heights of forty-seven to seventy-five feet in thirty years, depending upon the character of the soil. Where natural seeding fails, loblolly pine seedlings may be planted about six feet apart. Thinnings may be necessary as the trees grow.

A well-stocked acre may produce from 300 to nearly 1,000 board feet of sawtimber yearly. The production depends, as with other crops, upon the character of the soil, and the protection from fire and pests. Individual stands have been measured that had averaged 1,800 board feet a year on each acre for thirty-two years. After seventy years on fair to good growing sites 40,000 to 50,000 board feet of timber is a reasonable yield and stands may produce an income from thinning within thirty years.



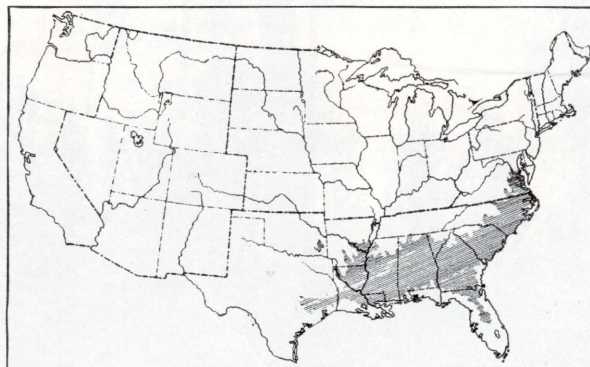
Sharp triangular spines are on each scale of the three to six-inch reddish brown cones



Deep furrows break the cinnamon-red bark into flat, oblong, scaly plates



A crowded cluster of yellow pollen-bearing blossoms and the early spring growth of a young Loblolly Pine



Natural range of Loblolly Pine

LODGEPOLE PINE

Pinus contorta, Loudon

LODGEPOLE PINE has been referred to as the most common conifer of the Northern Rockies. It grows from sea level to elevations of 11,500 feet, extending from the Yukon River down the coast of Alaska and British Columbia, through Washington, Oregon and California, and most of the Rocky Mountain region. Along the seacoast and in the bogs of the far North, the tree is frequently gnarled and stunted so as to deserve the name "scrub pine." Doubtless, the technical name, *Pinus contorta*, refers to the twisted branches of the botanical type characteristic of the coast, which is also reflected in the local name, "screw pine." In parts of the Rocky Mountains where it grows with Douglasfir, Engelmann spruce, alpine fir, and other trees, lodgepole pine is of commercial importance.

While commonly sixty to eighty feet high, it occasionally reaches 150 feet, and thirty to forty inches in diameter. Trees mature in about 140 years and may live to be 300 years old. It develops stands of more than 10,000 board feet to the acre. Lodgepole pine stands are estimated to contain 22,060,000,000 board feet, of which 21,000,000,000 board feet is in the Rocky Mountain region and the balance in the Pacific Northwest. The lodgepole pine lumber cut for 1946 was reported at 87,598,000 board feet, produced largely in Colorado and Wyoming with smaller amounts from Utah, Idaho, Montana and Oregon.

Some botanists recognize the more upstanding tree of the high mountains as a distinct species, while others call it a variety of lodgepole pine. Accordingly, it may be referred to as *Pinus murrayana*, or *Pinus contorta* variety *murrayana*.

The needles or leaves are bright yellow-green, occur in pairs, range from one inch to three inches but average about two inches in length, and remain on the trees six to eight years.

Fertile cones are borne nearly every year after the trees are fifteen years old. Heavy seed crops occur at intervals of three or four years. The cones are glossy, light yellow-brown, three quarters of an inch to two inches long, and often occur in clusters of a half dozen or more. Each thin scale is armed with a slender more or less recurved prickle. The cones ripen in August or September of the second season but may hang on the branches for years before opening and liberating their seed. Lodgepole pine seed have been known to show life after forty years.

In dense stands tall, clean, gradually tapering shafts with short, rounded, small-branched crowns are developed. Such shafts, five or six inches in

Lodgepole Pine of the Rocky Mountains frequently grows in dense, even-aged stands, attaining a height of one hundred and fifty feet, with breast high diameter of three feet or more



diameter, and flexible, were used by Indians to make their lodges or tepees, whence the name "lodgepole pine." Open stands result in dense rounded or pyramidal crowns of large, much-forked branches which may extend down to the ground.

The thin scaly bark of the trunk is pale brown with a grayish tinge, from half an inch to an inch thick, and irregularly divided by vertical and cross fissures into small oblong plates. The inner bark is prepared as food by the Indians of the Northwest and of Alaska. They also work it into baskets.

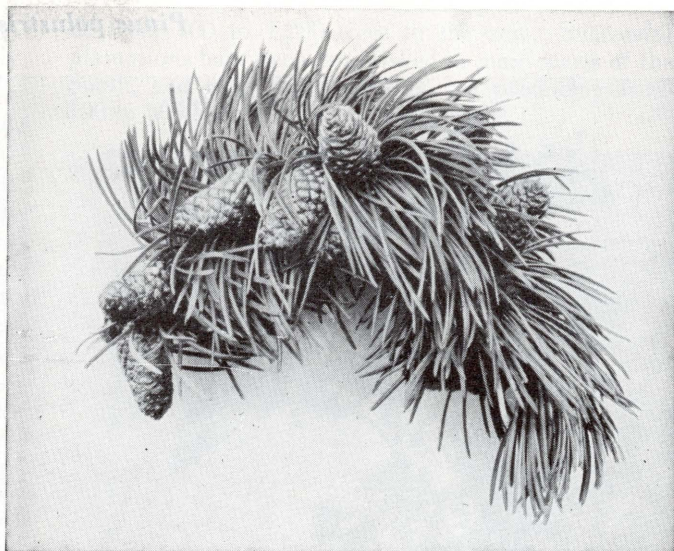
The wood is hard, stiff, somewhat brittle and straight-grained. The heartwood is usually light brown, tinged with red, while the thick sapwood is nearly white. A pebbled appearance on some boards has led to the name "bird's eye pine." The wood from coast trees is heavier, stronger and more dense than that from trees grown in the mountains, a cubic foot weighing about thirty-six pounds as compared with about twenty-five pounds for the mountain form. Lodgepole pine is used for railroad ties, construction lumber, fence and corral poles, house logs and fuel.

Although native only to the West, lodgepole pine has been successfully planted in various parts of the East. Specimens growing in the Arnold Arboretum, in Massachusetts, were planted about 1877 and others have been grown successfully at Letchworth Park in western New York since 1912 and 1914. Under natural conditions it avoids limestone soils and demands full sunlight for best growth.

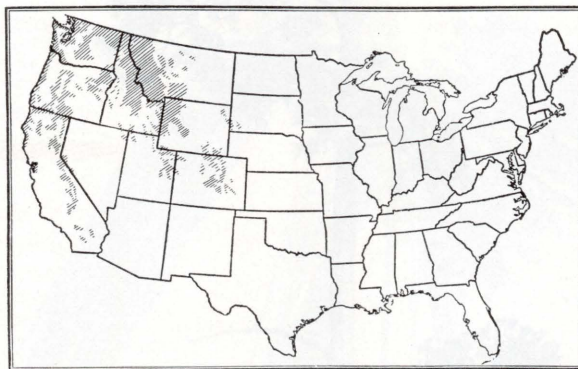
Fire destroys large areas of valuable lodgepole timber, but at the same time it prepares ideal conditions for the seedlings by exposing the mineral soil, removing competing vegetation and killing or driving away the birds and rodents who would otherwise feed on the seed. In dense lodgepole stands fires quickly develop into disastrous crown blazes, which destroy everything in their path. Even surface fires quickly burn through the thin bark and severely damage the stands. The cone scales, however, insulate many of the seed against damage, yet open most readily in the presence of heat, so that a heavy distribution of seeds frequently follows after a fire. The resulting lodgepole seedlings grow quickly in the fire-cleaned area, producing a dense stand without competition from other kinds of trees. This accounts for the phoenix-like power of lodgepole pine to take possession of areas following fires.

Mistletoe distorts many lodgepole trees, causing them to have thin crowns, sickly, pale, short needles and slow growth. Trees badly covered with mistletoe should be cut and removed when practicable. Heart rot is caused by canker infections from several kinds of wood-destroying fungi.

Serious damage is done great areas of lodgepole pine by western pine bark beetles, which bore under the bark and eventually girdle and kill the trees. Bark beetles can be controlled by peeling the bark from the trunk and stump of the tree and then burning it. Porcupines prove a lesser menace by gnawing off the bark from many trees.



The bright yellow-green needles are about two inches long and borne in pairs. The cones range up to two inches long and may remain on the tree for years before releasing their seeds.



Natural range of Lodgepole Pine in the United States



The pale brown bark of the main trunk is made up of many thin, irregular scales and is seldom more than an inch thick

LONGLEAF PINE

Pinus palustris, Miller



IN the original southern pine forest, longleaf pine outranked shortleaf, loblolly and slash pines, and was comparable to the present rank of Douglasfir in national importance. The temperate almost sub-tropical climate, combined with ample rainfall of the coastal plain from southeastern Virginia through North and South Carolinas, Georgia, Florida, Alabama, Mississippi, Louisiana and eastern Texas, furnishes desirable growing conditions. Trees of best development are found on moist but well-drained, deep, sandy loam, but they grow well on all sandy and gravelly soils within this range.

Literally translated, its botanical name *Pinus palustris* means the pine that lives in marshy places, but it grows on many different kinds of soil. Frequently growing with shortleaf, loblolly, and slash pines, it shares with them the common name of southern yellow pine, and in certain respects is the most desirable of them all. It is commonly known as "longstraw" pine.

The leaves, or needles, are eight to eighteen inches long, held three in a bundle, and drop off before the end of the second season. Like all other pines, separate male and female flowers are borne on the same tree during early spring. The male flowers appear as dark rose-purple catkins around the base of young shoots and bear yellow pollen. These shrivel and fall shortly after the wind has carried the pollen to fertilize the ovulate or female blossoms, which appear in pairs or small clusters at the ends of the upper branches. During the second season after fertilization these grow into cones five to ten inches long, and having matured, release the winged seeds which develop in pairs under each of the cone scales.

Longleaf pine frequently grows to heights of 100 to 120 feet, with a tall slightly tapering trunk from two to three feet in diameter. The orange-brown bark of mature trees is made up of many closely pressed papery scales and may be a half-inch thick.

The light red to orange-yellow heartwood is exceedingly hard, strong and durable, and within the tree is surrounded by a thin nearly white layer of sapwood. A cubic foot of the wood weighs 40 to 43 pounds when air dry. Its great strength and the large sizes in which it is available cause it to be favored above most others for construction. It is used for heavy girders in buildings and bridges, masts and spars, railway ties, flooring, interior finish and general construction, as well as for fuel and charcoal.

The stand of longleaf pine is not definitely known, but in the Deep South, where the species very largely occurs, there is estimated to be 19,000,000,000 board feet (chiefly in Florida, Alabama and Georgia), or ten percent of all the southern pines. The total stand of 188,327,000,-

Longleaf Pine — This aristocrat of the Southern pines frequently attains heights of 100 to 120 feet in the light sandy soils of the coastal plain from southeastern Virginia to western Texas

000 for the southern pines ranks second in our national storehouse of forest wealth, being exceeded only by Douglasfir.

No description of longleaf pine is complete without reference to the naval stores industry. This general term applies chiefly to turpentine and rosin, the principal products derived from the distillation of the pitch or crude gum which exudes from pine trees when "chipped" or wounded. It also is applied to similar products obtained by distilling the pine wood. Longleaf and slash pines are the chief gum-running trees from which naval stores are secured. Most of this is produced in the region from South Carolina to Mississippi. The value of these according to the 1939 United States census exceeded \$30,000,000. Paint and varnish, soap, shoe polish, paper, and printing ink use up most of the naval stores. Chipping of the trees and distilling the gum employs several thousand people and is one of the major forest industries of some portions of the southeast.

Longleaf pine produces vigorous seedlings which grow slowly above ground during the first few years because of the energy spent developing a long tap root and large root system. After four or five years the longleaf saplings begin to grow rapidly and continue for thirty-five to fifty years, producing in that period trees fifty-five to eighty feet tall and seven to eleven inches in diameter. Timber growth of 300 to 500 board feet an acre a year in full stands is not uncommon throughout the longleaf area.

Fire and hogs are the worst enemies of longleaf pine. During the early seedling stage light grass fires do comparatively little harm, but this apparent immunity becomes less effective as the trees get taller. While the small trees have what is sometimes called an "asbestos bud," their sweet succulent roots appeal to hogs that range much of the Southern pine country. A single "razorback" hog with a taste for pine roots may destroy hundreds of little trees in a day.

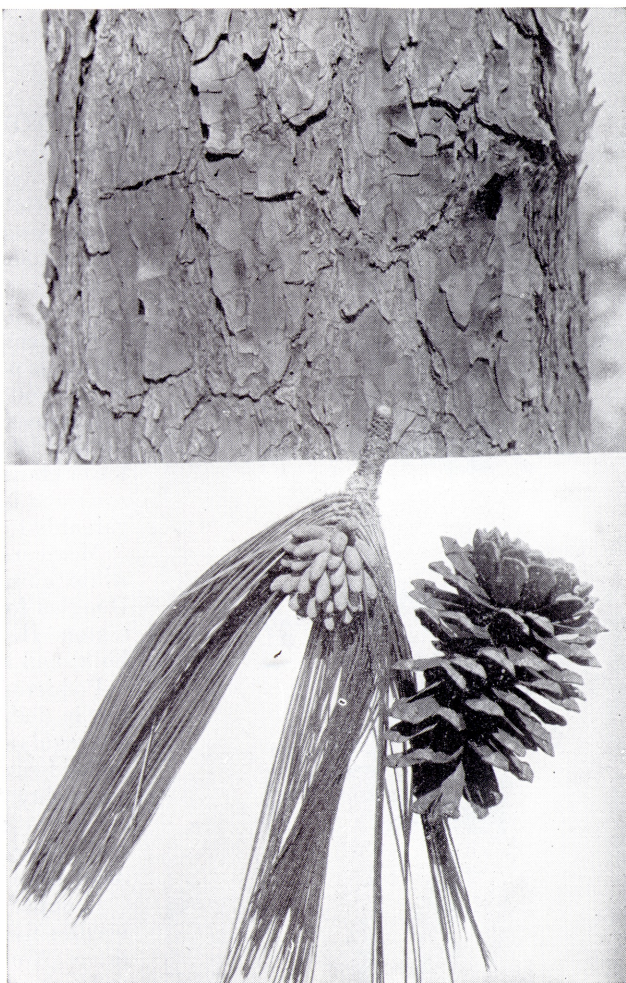
Again, after the trees have attained a fair size and have been wounded or "faced" for gum, they are easily damaged by fire. These faces start a few inches from the ground, and being covered with dry gum or pitch burn easily. In spite of constant efforts fires continue to rob the South of millions of dollars in present and future timber values.

Various insects and fungus diseases attack longleaf pine, but the one most generally recognized is the Southern pine beetle. Attacks by these tiny insects upon the living trees may be partially prevented by not cutting timber in the hot season, or if it must be cut, by piling and burning the brush as quickly as possible. Infested trees should be used at once, and all brush and bark should be burned.

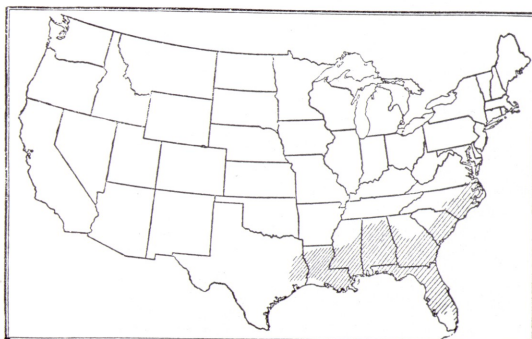
Longleaf pine bears large crops of seeds at intervals of three to five years, with a few seed from open stands nearly every year. Where seed trees are left, and fire and hogs kept out, it re-establishes itself after a lumbering operation. Since 1920 Louisiana has required timber operators to leave at least one seed tree, eight inches in diameter, to the acre.

Where seed trees are not available seedlings may be grown in a nursery and transplanted after the first year. Set out at intervals of six to eight feet there will

be from 700 to 1,200 trees to the acre. Successful plantations have been established in many parts of the South, and with fire protection are producing from 100 to 500 board feet to the acre yearly.



The orange-brown bark, furrowed and crossed into closely pressed scales may be confused with that of some other pines, but the long, flexible, shiny, dark-green needles, held in groups of threes, are characteristic of Longleaf Pine. The reddish brown mature cones are five to ten inches long, with thick scales that turn back to release the winged seeds. At the base of the leaves is a cluster of pollen-bearing staminate blossoms



Natural range of Longleaf Pine

PONDEROSA PINE

Pinus ponderosa, Douglas

K NOWN until recently as western yellow pine, and by a variety of other names, this tree of the western mountains is now recognized as ponderosa pine. It grows in fairly open stands from British Columbia and the Black Hills of the Dakotas southward in the Pacific and Rocky Mountain regions to western Texas, New Mexico, Arizona and on into northern Mexico and Lower California. Northern and Pacific Coast forms have been differentiated from the southwestern ones but this description includes all forms under the single heading. In different parts of its range there is noticeable variation in length and thickness of the needles, size of the cones, color of the bark and texture of the wood.

It grows on well-drained uplands and mountain slopes up to elevations of 12,000 feet in the southern part of its range and in dry valleys at lower elevations in the north. In the Colorado plateau of northern Arizona and New Mexico it constitutes over four-fifths of the stand in vast valuable forests at elevations of 6,500 feet to 10,500 feet above sea level.

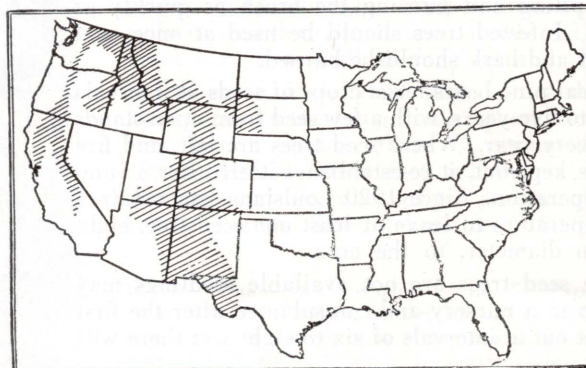
Members of the Lewis and Clark expedition first reported it in 1804, while going up the Missouri River. Twenty-two years later, David Douglas found trees growing near the Spokane River in eastern Washington. He suggested the name *ponderosa*, because of the ponderous bulk, and sent seeds to European gardeners.

Ponderosa pine trees attain heights of 150 to 230 feet and five to eight feet in diameter at breast height. They may be 350 to 500 years old and the regular spire-like head surmounts a massive trunk whose irregularly divided scaly bark is cinnamon-brown to orange-yellow. Until the trees are eighty to one hundred years old the bark is less broken and dark brown to nearly black. This accounts for the name blackjack pine and the occasional idea that the dark barked trees are unrelated to the older trees with the brighter colored bark.

Grouped botanically among the pitch pines, ponderosa pine has needles five to ten inches long which are borne in clusters of two and three. Normally these remain on the twigs from three to seven years.

The brown cones are three to six inches long and are frequently in a cluster. Before the seeds ripen the cones are bright green or purple and stand erect on their short stalks. As they ripen they become a reddish brown, turn down and the scales spread open for the winged seeds to escape. Ordinarily there are two full rounded somewhat triangular seeds about a quarter of an inch long under each scale. The wings are broadest below the middle and an inch to an inch and a quarter long, are so balanced with the seed as to carry it on a wind from 200 to 1,000 feet from the parent tree. Frequently when the mature cones break off, a few of the scales are left hanging to the stems.

Although the seeds have a strong resinous flavor, making them inedible, the western Indians strip the bark in spring and scrape it for the



Natural range of Ponderosa Pine in the United States

Forest grown trees may lift their crowns more than 200 feet above the ground, and attain an age of 500 years

sweet nutritious layer of living cambium. A spicy odor as of orange peel which sometimes seems to pervade the entire forest is given off by the twigs when crushed.

The hard, strong, comparatively fine-grained wood is light red with a narrow band of nearly white sapwood and weighs twenty-five to twenty-eight pounds to the cubic foot when air dry. The light weight has led to its confusion with white pine. A fungus known as "blue stain" frequently disfigures the sapwood of trees cut in warm, damp weather, but does not materially reduce its strength. The wood is widely used for general construction, interior finish, boxing and crating. It is not strong enough for heavy construction and is too easily attacked by fungi to be used in contact with the soil.

The estimated merchantable stand of 185,441,000,000 board feet of ponderosa pine and Jeffrey pine timber in the United States is exceeded only by the stand of Douglasfir and southern pine, while the amount of lumber cut ranks fourth. In 1946, the cut of ponderosa and Jeffrey pines was approximately 3,650,000,000 board feet. Oregon and California produce about two-thirds of the total.

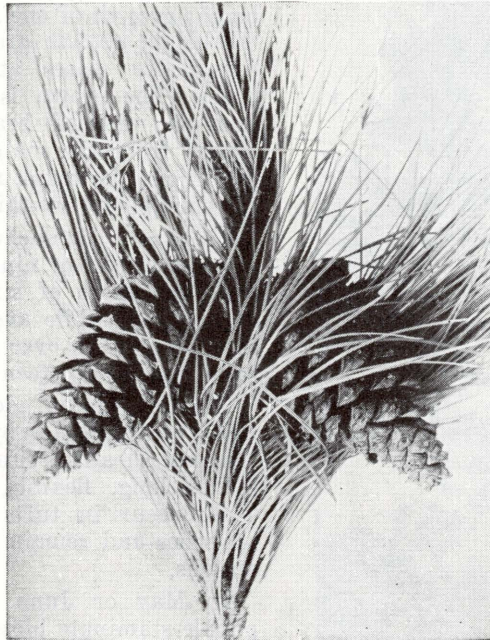
Ponderosa pine grows vigorously from seed and adapts itself to forest plantings. It has been successfully planted over its natural range, and to a considerable extent in the eastern states, but is not generally a rapid grower. There are so many other trees better adapted to eastern conditions that it is not recommended for planting outside of the area where it is native.

Subject to a number of insect and fungus enemies, the resistance of the tree is evidenced by its wide distribution, the large areas of forest in which ponderosa pine predominates, and the great age and size which it frequently attains. Next to fire, the two most serious enemies of ponderosa pine are the *dendroctonus* bark beetle and mistletoe. Attacks by bark beetles may follow fire damage and frequently accompany mistletoe. This is a less showy form of mistletoe than that associated with Christmas decorations, but is a parasite to be reckoned with in any form of forest management. The mistletoe centers its attack largely upon the limbs and branches, while the bark beetles channel beneath the bark of the trunk and kill the tree more quickly.

Two forms of needle disease are common which either distort the needles or cause them to die. In neither case do these diseases kill the trees, but they materially reduce the rate of growth.

In Oregon and other parts of the West caterpillars of the pandora moth have eaten the needles from large areas of merchantable pine. They reach proportions of an epidemic at fairly regular intervals of twenty or thirty years, and continue abundant for six to eight years.

The size of the trees, the great area over which they grow and the relative inaccessibility of many of the timber stands make absolute control impracticable. Although mature trees are fire-resistant, foresters in charge of forests of ponderosa pine face a real problem in keeping its enemies, including fire, within bounds.



Woodbridge Metcalf

The green cones maintain an upright position into their second year, when they become brown, turn down and release the seeds from between the back-spread scales. Usually three, but occasionally two needles are held in a cluster



Close pressed papery layers or scales make up the bark which is cinnamon-brown to orange-yellow in the older trees, but nearly black in trees younger than eighty or 100 years

RED PINE

Pinus resinosa, Aiton

THE straight clean trunk and reddish brown bark of the red pine is a familiar feature of the forest stands of the Northeast from southern Canada throughout the northern states from



Red Pine attains heights of eighty feet or more

Maine to Minnesota, and south as far as Pennsylvania. Scattered specimens are found in West Virginia. It reaches its optimum development on sandy plains in the Great Lakes region, as well as on dry, gravelly ridges of the more eastern states.

Known widely as Norway pine, this tree is usually from sixty to eighty feet high with trunk diameters two to three feet at breast height. Occasional trees attain a height of 140 feet with a diameter of four and a half feet. It seldom attains an age of more than 300 years and declines in vigor after 200 to 230 years. During the first sixty or seventy years, the red pine is capable of an average height growth of one foot a year. Thereafter, the height growth gradually declines until it practically ceases at around one hundred years. The crown is symmetrically conical, and the whorled branches extend at right angles from the main trunk. Under forest conditions the trunk may be free of branches for one-half to two-thirds the total height.

Stands in Massachusetts have attained an average height of ninety-one feet with breast high diameters of sixteen inches in eighty-eight years, while average trees in a Minnesota stand were over 200 years old and measured nearly nineteen inches in diameter.

The dark green, glossy leaves are borne in pairs held together by long, persistent membranous sheaths. Each leaf is four to six inches long, flexible, and sharply pointed. They occur in tufts near the ends of the branches and remain on the tree four or five seasons.

In May or June dense clusters of dark purple staminate blossoms about half an inch long occur at the base of the current season's growth, while near the ends of the upper branches on the same tree are less evident pairs of short-stalked, broadly egg-shaped, scarlet, ovulate flowers. The short compact character of the ovulate flower is retained as the cone develops to maturity through the succeeding two seasons.

The light, chestnut-brown, broadly conical cone is about two inches long, and grows without a stalk at right angles to the parent stem. Each cone scale is slightly thickened at the end, and unarmed. No other pine tree native to the northeastern states has cone scales without a spine or bristle. While the cone may remain on the tree through the winter, most of the winged seeds are shed early in the autumn. Ordinarily, a bushel of cones will yield a half to three-quarters of a pound of mottled brown, oval seeds about an eighth of an inch long and requiring some 50,000 to make a pound. Never a prolific seed bearer, the cones occur, high in the crown, at intervals of two to four years. Except during

logging operations seeds are difficult to gather and bring relatively high prices.

An outstanding feature of the tree is the reddish brown bark, divided by shallow fissures into broad, flat ridges, with thin, irregular, flaky scales. The bark is three-fourths to one and one-half inches thick, and rich in tannin. The color is partly responsible for the common name—red pine.

The name *resinosa* is not particularly appropriate in that it indicates a pine "full of resin." Living red pines have never been a source of turpentine, but gum spirits are sometimes produced in a small way by burning the stumps in specially constructed stills. An accepted name—Norway pine—is credited to an early explorer who confused the tree with Scotch pine, *Pinus sylvestris*, which grows in Norway.

The pale red, close-grained heartwood, surrounded by a moderately thick layer of light yellow sapwood, weighs thirty to thirty-four pounds to the cubic foot when air dry. The annual rings are fairly conspicuous. Heavier than white pine, it is also stronger and stiffer. It is, however, neither so heavy nor so strong as longleaf pine. The wood is of considerable commercial importance, being used for general construction, piles, door and window frames, sash, flooring, boxes, crates, ship masts, and ship flooring. It is not durable when used without treatment in contact with the soil. In commerce it is frequently sold in mixture with white pine, and there are no separate figures for its annual production.

A survey made by the U. S. Forest Service in 1938 showed a stand of approximately 1,500,000,000 board feet of red pine of saw-timber size, 1,000,000,000 board feet of which was in Minnesota, 300,000,000 board feet in Wisconsin, and 200,000,000 board feet in Michigan. In the statistics on lumber production, red pine and jack pine are included with Eastern white pine. If the lumber produced from the three species is proportional to their stand, the average annual cut of red pine in recent years is 24,000,000 board feet.

While pure stands of red pine are found in the Lake States, it grows more frequently in mixture with white pine and jack pine. It also grows in mixture with hardwoods.

While the thick bark is fairly resistant to fire, red pine has the ability to reproduce heavily after fire, and to grow rapidly during the seedling and sapling stages. It is more resistant to insects and diseases than white pine, but even less tolerant of shade, and is frequently used for forest planting in the northeastern states. Its rich color, attractive form, vigorous growth, and the ease with which it may be transplanted make it popular for ornamental planting. The quality of the lumber gives it a place of increasing importance in forest management.

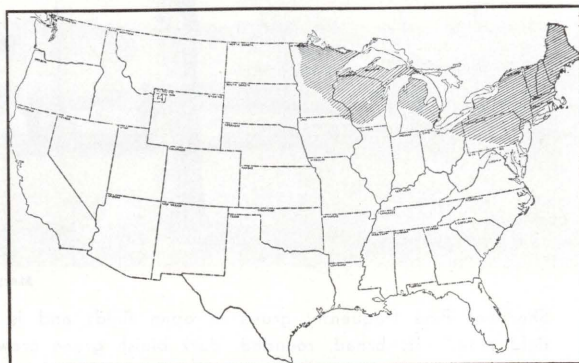


William M. Harlow

Each pair of needles is four to six inches long, while the cone is without spines or prickles



The reddish brown bark flakes off in irregular scales



Natural range of Red Pine in the United States

SHORTLEAF PINE

Pinus echinata, Miller

SHORTLEAF PINE—one of four important southern yellow pines—attains commercial importance in Arkansas, Virginia, Missouri, Louisiana, Mississippi, Texas, South Carolina and North Carolina, but is found in varying abundance from Long Island and southwestern Pennsylvania south and westerly to eastern Texas and Oklahoma. It prefers well-drained light sandy or gravelly clay soil. On moist soils along the coastal plain it is crowded out by loblolly pine and longleaf pine with which it is often sold as lumber. A very hardy tree, shortleaf pine can withstand lower winter temperatures

than any of the other important southern pines.

The long clean trunk has little taper and is surmounted by a relatively short, pyramidal or rounded crown consisting of limbs arranged in more or less regular whorls. The oldest and stoutest of the limbs are rarely over twenty-five feet long and somewhat drooping. Trees eighty to one hundred feet high and two to three feet in diameter are not uncommon, but trees one hundred and twenty feet tall and four feet in diameter have been recorded. It reaches maturity at about one hundred and twenty years and occasionally

lives over three hundred years.

The bark of old trees is yellow tinged with cinnamon-red, broken into irregular plates which peel off into thin scales. Bark on young trees and branches is smooth and green, becoming brown and scaly with age.

The slender dark bluish green leaves are three to five inches long, occur in clusters of two or three and remain on the tree for two to five years.

In April or May the pale purple pollen-bearing staminate blossoms cluster at the base of the new leaf growth, while the cone-bearing ovulate flowers are borne two or four in a whorl on stout erect stems below the new growth. The short-stalked, dull brown, egg-shaped cones reach a length of one and a half to two and a half inches and mature in two seasons. They are the smallest cones of the four important southern pines. Each cone scale is terminated with a temporary prickle or broad-based spine. This characteristic is responsible for the scientific name *echinata* derived from the Latin word *echinus*, meaning hedgehog. Under each central cone scale are two pale brown triangular seeds about three-sixteenths of an inch long, each provided with a wing about one-half an inch long and one-eighth of an inch wide. When the cone opens the seeds drop out and may be carried several hundred feet by the wind. They germinate evenly and quickly, and frequently find places for growth in abandoned open fields, which gives rise to the common name "old field pine." It is more often called yellow or "short straw" pine, and rosemary pine.

It is unusual among all pines because of its ability to sprout



Maryland State Department of Forestry

Shortleaf Pine frequently grows in open fields and is commonly called "old field pine." Its broad, rounded, dark bluish green crown with long somewhat drooping branches surmounts a straight cinnamon-red trunk

from the stump, or when injured by fire. This is characteristic of young trees and is lost after they are six or eight inches in diameter.

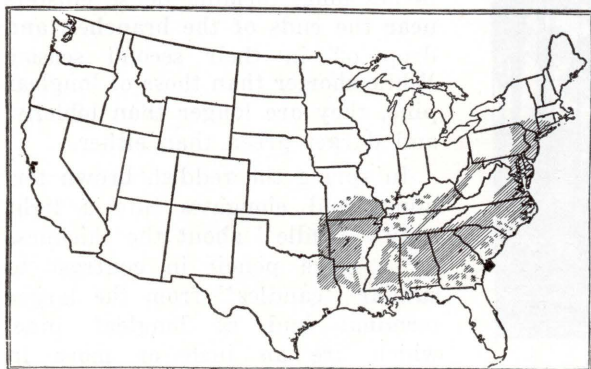
The yellowish wood is noticeably grained, moderately hard, strong and stiff. It resembles that of longleaf pine with which it is frequently sold, but is lighter and less strong. A cubic foot of air-dry shortleaf pine wood weighs thirty-six to thirty-nine pounds, as compared with forty to forty-four pounds for longleaf pine. It is used extensively for house-building materials, including framing, ceiling, weatherboarding, panels, window and door frames, casing and carved work. The grain shows well in natural finish or when stained. Frames of overstuffed furniture, chairs, desks, agricultural machinery, excelsior, wood pulp, mine props, barrels and crates are also made of shortleaf pine.

Estimates of shortleaf pine standing timber are included under "southern pine," which amount to 188,327,000,000 board feet. Probably one-third is shortleaf pine, largely in Arkansas, Texas, Georgia, Alabama and Mississippi, and the same proportion might also apply to the 9,500,000,000 board feet of southern pine lumber produced in 1946.

It grows associated with loblolly pine, oaks, hickories and sweetgum, but extensively in stands comprised only of shortleaf pine. Whole stands frequently attain an average height of fifty or sixty feet and nearly nine inches in diameter in thirty years. Such a stand may contain nearly fifty cords of wood capable of being cut into about 6,000 board feet of lumber. Assuming that the trees are sound and straight, the volume rapidly increases as the trees mature. At fifty years they may be ten to twelve inches in diameter and the volume of saw material will be from 20,000 to 40,000 board feet to the acre. Stands of more than 50,000 board feet to the acre are relatively uncommon as the timber is usually cut before it reaches that size.

Shortleaf pine, along with all other southern forest trees, suffers from the yearly burning of the woods. Not only are the immature trees killed, but the mature ones are seared and weakened, leaving them prey to injurious insects and fungi. The ability to sprout only partially offsets the damage and in no case makes up for the removal of the natural mulch of leaf litter from the soil. Next to the loss from fire is that from attacks of the southern pine beetle. This insect attacks the living trees and is particularly active after long dry periods, but will not live through winter temperatures of zero or colder. Other enemies include such insects as the pine sawyer, the Nantucket tip moth, and fungus diseases such as "red heart," whose spores frequently enter the tree through wounds caused by fire.

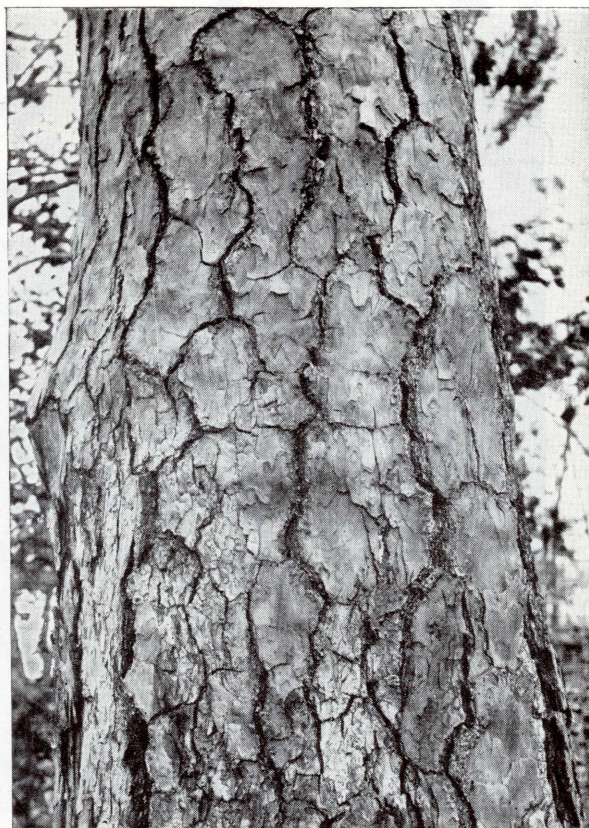
Aside from its value for timber, the broad pyramidal head, straight symmetrical trunk, and vigor result in shortleaf pine being recognized as a handsome park or lawn tree.



Natural range of Shortleaf Pine



The three to five-inch long needles are borne in clusters of two or three. Prickles on each cone scale help distinguish this tree



The scaly bark of mature trees is almost cinnamon-red and broken into more or less rectangular plates

SLASH PINE

Pinus caribaea, Morelet

SLASH PINE ranks high among the rapid growing, early maturing pines of the southern coastal plain. Because of its

ability to produce heavy stands of timber and its yield of high quality resin, it is probably the most profitable of all southern timber trees.

It grows on low ground and on hummocks in swamps or moist "slashes" from southern South Carolina to the keys of Florida and westward across Georgia, Alabama, and Mississippi to eastern Louisiana. It also occurs in Central America, Cuba, the Isle of Pines, the Bahamas, and other islands of the Caribbean Sea, which explains its scientific name *Pinus caribaea*. The southern extremity of its range, including lower Florida, produces pure forests of slash pine, while elsewhere it may be associated with loblolly and longleaf pine.

Best growth and purest stands are attained in Florida and southern Georgia, where trees rise to heights of eighty to 150 feet and attain trunk diameters of two to three feet. The average height is about 100 feet, with clear lengths of sixty or seventy feet surmounted by a dense, rounded crown of heavy horizontal limbs. During its first twenty to fifty years, slash pine exceeds all of the southern pines in growth, reaching heights of forty-five feet and diameters of six inches in twenty years, and attains over eighty feet in height and fifteen inches in diameter by fifty years. Trees mature at about one hundred years but may reach ages of 150 to 200 years.

The dark lustrous green needles grow in bundles of two, three, or more—but are most frequently in pairs. They are eight to twelve inches long, forming dense clusters near the ends of the branches, and drop off in their second season. While shorter than those of longleaf pine, they are longer than loblolly, and darker green than either.

In spring the reddish brown terminal bud elongates into a light gray "candle" about the thickness of a large pencil in contrast to similar "candles" from the larger terminal bud of longleaf pine, which are an inch or more in diameter.



The rapid growing, early-maturing Slash Pine is one of the profitable timber trees of the South Atlantic and Gulf States

During January and February, before leaf growth starts, dark purple staminate flowers appear in crowded clusters at the base of twigs of the previous year's growth, while at the ends of the same or similar twigs are pink ovulate flowers on long stems which develop into small erect cones. They hang down during the second season, and by October have matured into glossy, leathery brown, egg-shaped cones three to six inches long. The thin, flexible cone scales are each armed with a slender, slightly recurved prickly. These prickles, borne on the varnished end of each cone scale, are peculiar to slash pine.

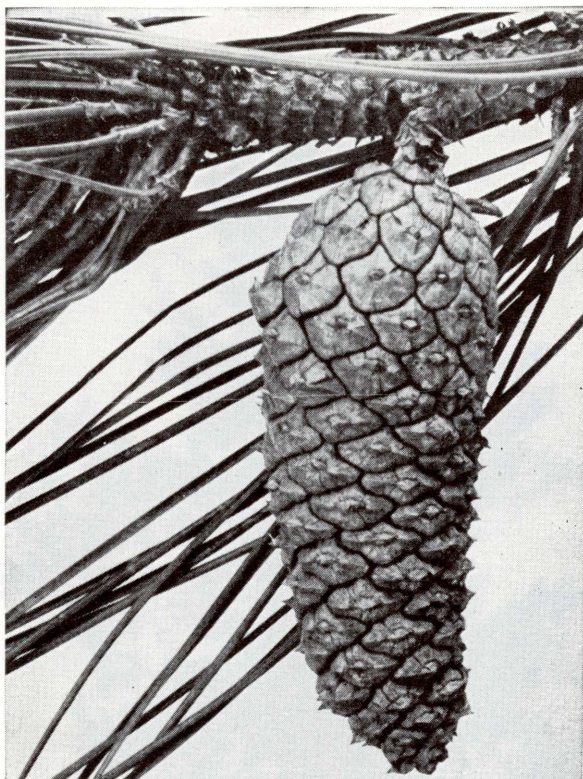
Under each cone scale is a pair of mottled dark gray winged seeds. Large crops are borne every two or three years, which are carried by the wind to assist in this tree's aggressive reclamation of old fields and cut-over areas. There are 16,000 to 18,000 clear seed in a pound, with sixty to ninety out of every 100 seed fertile.

The bark is clear orange to red-brown, one-half to three-quarters of an inch thick, consisting of many overlapping, irregular plates or scales which form broad flat ridges on the trunk. Turpentine workers invariably associate the orange bark with free flowing resin qualities, for slash pine excels all other southern pines in production of rosin or gum containing a large content of spirits of turpentine.

The light brown to rich orange wood is coarse-grained, resinous, brittle, without durability in contact with the soil, and a cubic foot weighs — when air dry — about forty-eight pounds. Accordingly, it is the heaviest of all pines and comparable to the hickories and white oaks. The wide sapwood is nearly white. It so closely resembles the wood of longleaf pine that a distinction is seldom made when the lumber is marketed. Large quantities of second growth timber are cut for railroad ties, increasing amounts for wood pulp, and mature trees are used for general construction and interior trim.

The moist location of most slash pine stands provides natural protection against fire, but trees are often subject to red heart rot.

Slash pine is one of the most rapid growing and early maturing of all eastern forest trees. Because of its capacity to produce wood pulp, fuel, lumber, and naval stores, as well as its adaptability to moist, sandy soils within its range, it is being extensively planted in several of the southern coastal states. Moreover, it is recognized for its unusual beauty and is being used to an increasing extent for landscape and roadside planting in the South.



William M. Harlow

The short-stalked three to six inch cones are armed with distinct prickles on each cone scale. Leaves are in bundles of two or three



Irregular orange colored plates lie one over the other to make a half-inch layer of bark



Natural range of Slash Pine in the United States

SUGAR PINE

Pinus lambertiana, Douglas



SUGAR PINE is the tallest and most magnificent of all the pines. It is one of the *Quinae*—or five-leaves-in-a-bundle pines—and is confined to a narrow strip about 1,000 miles long extending from southwestern Oregon, along the western slopes of the Sierra and Coast ranges of California at elevations of 1,000 to 9,000 feet above sea level, to lower California. Heights of 245 feet, and diameters, breast high, of twelve to eighteen feet have been recorded, but trees 160 to 180 feet high and four to seven feet in diameter are more common. The straight cylindrical trunk of mature trees frequently rises fifty to eighty feet to the first few long horizontal limbs which form the base of a wide crown. These great branches sweep outward and downward in graceful curves. With maturity, the spire-like outline of young sugar pine assumes a flattened top similar to that of old Eastern white pines. Trees attain ages of 300 to 500 years, and occasionally nearly 600 years, and stand on a broad, shallow root system.

First recorded in 1825, on the Multnomah River in southern Oregon, by David Douglas, it was named *Pinus lambertiana* in honor of his friend, Dr. Aylmer Bourke Lambert, a distinguished British botanist of that time, and author of a book on pines. The name sugar pine refers to the white crisp globules of resin which exude from the bark after injury. These are sweet, with a pleasant suggestion of pitch flavor, and possess certain cathartic qualities.

Like all true white pines, the deep blue-green needles which have a whitish tinge are borne in groups of five. They are two and a half to four inches long, stout, stiff, twisted, and remain on the twig through the third year. In early spring light yellow, pollen-bearing flowers, half an inch to an inch long, are borne in clusters on young twigs, simultaneously with light green or pale purple ovulate cones. Before maturing the cones become dark purple-brown, and stand erect, giving rise to the name "Purple-coned Sugar Pine." By August of the second year, the cones, which are the largest of all pine cones, become pendulous. They attain lengths of eleven to eighteen inches, or occasionally twenty-one inches, and two and a half to three and a half inches in diameter. In October the scales expand to release hundreds of dark, chestnut-brown, winged seeds. Each has a wing one and a half to five inches long, and an edible kernel about the size of a grain of corn, which is relished by many birds and mammals. The cones remain on the tree for two or three years. Heavy seed crops occur only at intervals of four to six years and trees under twenty inches in diameter seldom bear. The seeds are carried by the wind about

Largest of all pines, the Sugar Pine, magnificent Pacific Coast tree, attains mature heights of 200 to 245 feet

the same distance as the height of the tree. They germinate best on loose, moist soil with a little litter of decayed leaves.

The bark of mature trees is deeply and irregularly grooved into long plate-like ridges, covered with loose purple-brown to cinnamon-red scales, and is two to three inches thick. On young trees the bark is thin, smooth and dull dark gray in color.

The light colored, soft, straight-grained wood is fragrant, and satiny when planed. It is similar to that of Eastern white pine, except that it is whiter, changes color less on exposure, has more conspicuous resin ducts, and has a slightly coarser texture. The wood weighs twenty-two to twenty-five pounds to the cubic foot when air dry. Although not as strong or stiff, it enters into all the uses of Eastern white pine. Its remarkable freedom from any tendency to warp and twist with changing moisture, its durability in contact with the soil, and the large boards which are possible, cause it to be used for general construction, interior trim, patterns, and model making.

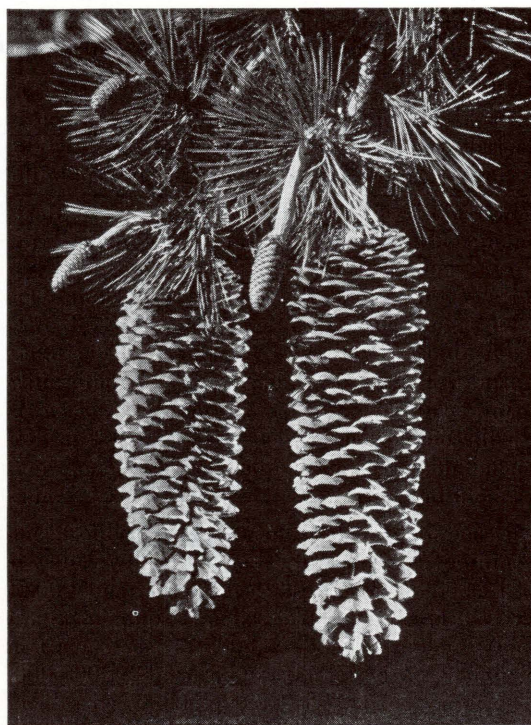
Sugar pine is produced only in Oregon and California where it ranks in volume and value with redwood. The lumber cut increased from 150,000,000 board feet in 1920 to 349,000,000 in 1929, and to a maximum of approximately 370,000,000 in 1932. The reported cut for 1944 was 317,800,000 board feet and the 1946 cut about 250,000,000. The present stand is estimated by the U. S. Forest Service to be 23,000,000,000 board feet, and approximately four-fifths of it is in California.

It grows at elevations of 1,000 to 2,000 feet in the Coast Range, and from 6,500 to 9,000 feet in the Sierras, in loose, deep, moist but well-drained sandy loams where air humidity as well as soil moisture are favorable. Best growth is found in the mountains where the annual precipitation is forty inches or more. Western yellow pine, white fir, Douglasfir, incensecedar, Jeffrey pine and giant sequoia are its principal associates.

Seedlings and trees up to twelve inches in diameter are easily damaged by fire. Thereafter the thick bark and high crown protect the trees against ordinary fires. Lightning is a frequent source of damage because the larger trees stand out above their fellows. Young trees are occasionally attacked by mistletoe, which kills or stunts them. Snow frequently accumulates to a depth of ten or fifteen feet, causing severe breakage to small trees, followed by insect damage, but until white pine blister rust entered the western forests, sugar pine was remarkably free from serious enemies. Because of its great value the federal government is co-operating with California and Oregon and with private owners to control the disease by destroying all currant and gooseberry bushes within its commercial range.

Sugar pine sustains a rapid rate of growth to a remarkably advanced age. During its first century of life, favorably located sugar pine will average one foot in height-growth each year. Many acres with 192,000 board feet of merchantable timber have been recorded, while 75,000 to 150,000 board feet to the acre are not uncommon. The ability of young sugar pine to endure shade enables it to start among other species, but as it grows older it demands more and more sunlight. It meets severe competition, however, from ponderosa pine.

Although not widely planted for reforestation or ornamental purposes in the West, individual specimens of sugar pine have been established in a number of eastern states. It has proved hardy in sheltered locations, as far north as Massachusetts, but under these conditions grows more slowly than the native Eastern white pine, *Pinus strobus*. David Douglas introduced it in England in 1827, and occasionally specimens are now found among collections of trees in various parts of the British Isles.

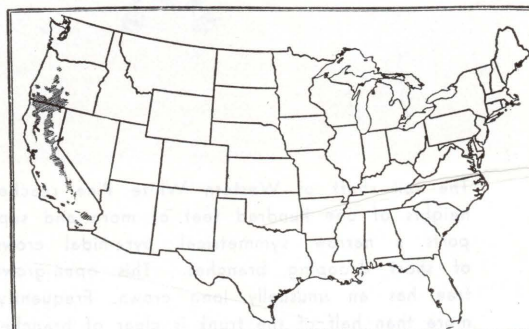


National Park Service

The largest of all pine cones, Sugar Pine cones are ten to twenty inches long, brownish purple, with the tips of the scales a lustrous chestnut-brown



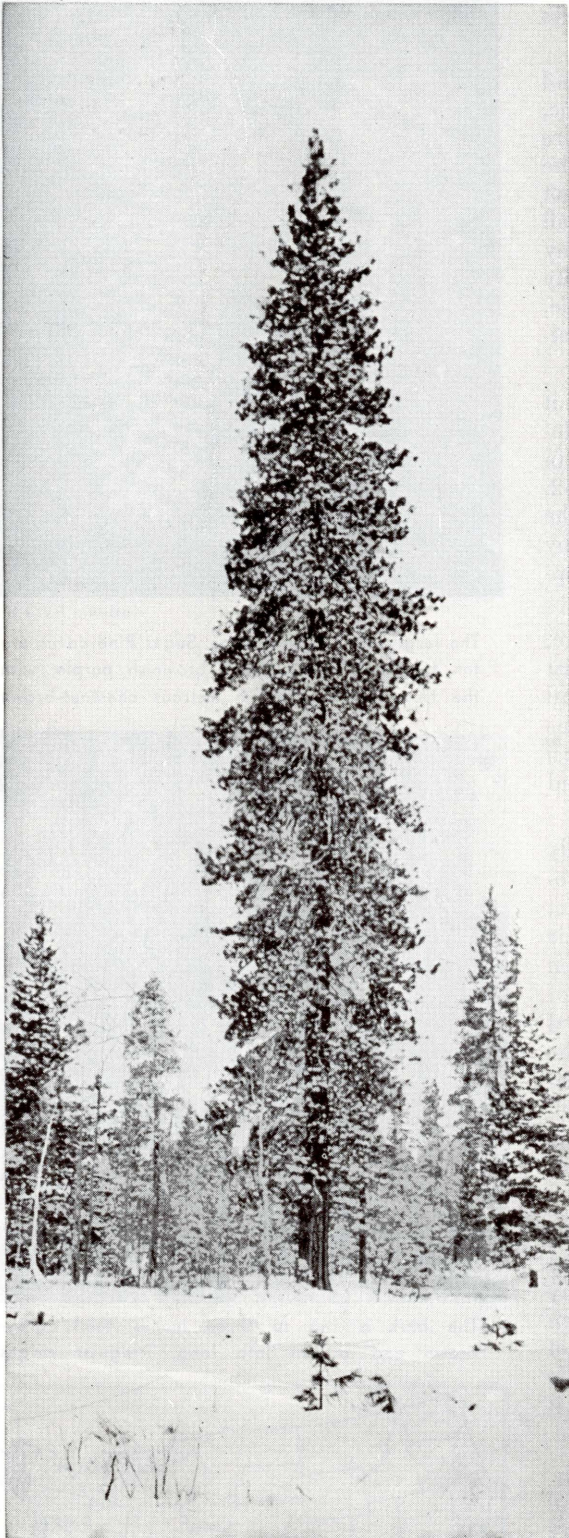
The bark is two to three inches thick, gray-brown and broken into long, irregular ridges



Natural range of Sugar Pine in the United States

WESTERN WHITE PINE

Pinus monticola, Douglas



The tall shaft of Western White Pine reaches heights of one hundred feet or more and supports a narrow, symmetrical, pyramidal crown of short drooping branches. This open-grown tree has an unusually long crown. Frequently, more than half of the trunk is clear of branches

WESTERN WHITE PINE—the silver pine of the Northwest, is native to the region from southern British Columbia across northern Idaho, Montana and Washington, southward through Oregon into California. True to its name, *monticola*, it is confined to the mountains, where in Idaho and Montana it is found at elevations of 2,000 to 5,000 feet above sea level, somewhat higher in Washington and Oregon and up to 10,000 feet in California.

Ranking among the important timber trees of America, Western white pine frequently grows in dense stands and develops a tall, slender shaft with a peculiarly short-branched, narrow, symmetrical crown. The trunk is usually clear for a half to two-thirds of its length, has little taper and the slender drooping branches seldom extend more than twelve to fifteen feet. These trees may reach heights of 175 feet and be eight feet in diameter at breast height, but they are more often ninety to 110 feet high and two to three feet in diameter. Rapid growth is combined with long life, for trees of 200 to 500 years are not uncommon.

The silvery gray bark sometimes takes on a tone of purple and is broken into small oblong or rectangular blocks. Trees exposed to the wind become distinctly cinnamon in color. Even on mature trees the bark is seldom over one and one-quarter inches thick, while that of young trees and branches is thin, smooth and bright gray. Very young twigs and shoots are covered with a fine reddish down, which helps distinguish this tree from other white pines.

The pale bluish green leaves or needles are two to four inches long, commonly with a white, frosty appearance and are borne in bundles of five. They differ from the needles of the Eastern white pine in being thicker and more rigid. They persist on the twigs for three or four years or even longer.

The yellow pollen-bearing, staminate flowers or catkins are borne during early spring in clusters of six or seven on the lower branches, while near the ends of the high branches are pale purple ovulate flowers on long stalks. From these higher blossoms develop green or dark purple cones which first stand erect, becoming pendulous by the close of the first season. By the end of the second summer they turn a yellow-brown and mature to a length of six to ten inches—or occasionally eighteen inches. The slightly curved cones are longer than those of Eastern white pine and so slender as to give rise to the name "Finger-cone Pine." Trees seldom bear fertile cones before forty to sixty years of age, and then infrequently at intervals of two or more years. Under each cone scale may be found two pale red-brown seeds about a third of an inch long attached to a narrow membranous wing from three-quarters of an inch to an inch long. The seeds are shed in September and October soon after the cones ripen and may be carried by the wind several hundred feet from the parent tree. Buried in the duff and well shaded, the seeds retain their vitality several years. Over most of its range the tree reproduces sparingly and the seeds germinate best on exposed moist mineral soil, or on humus which keeps moist through the growing season. Many of the existing stands of white pine came into being as even-aged forests following the forest fires of 1889 and 1910, from seeds stored in the duff or released from cones that escaped

destruction. Seedlings and young trees will endure shade, but as the tree becomes older more and more sunlight is demanded.

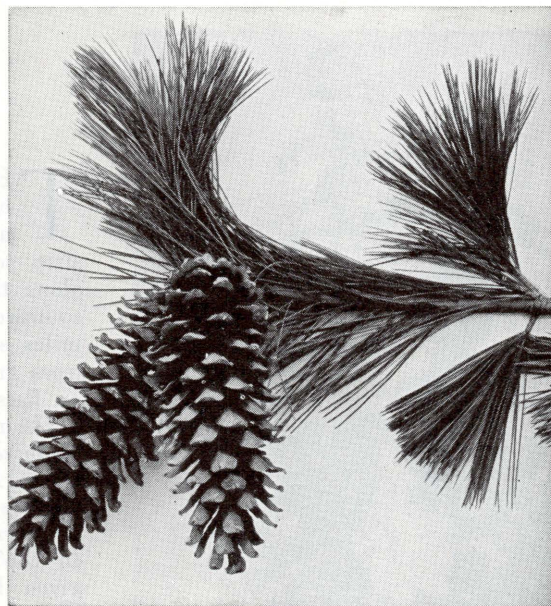
The pale brown to nearly white wood weighs only twenty-four to thirty pounds to the cubic foot, is straight-grained and easily worked. Although not strong, it is harder and stronger than Eastern white pine and for many purposes compares favorably with cypress, any of the spruces and Douglasfir. Its high commercial value is attested by the fact that among the species with which it is associated few command a higher price. With an estimated total stand of about 17,000,000,000 board feet of merchantable timber growing on some three million acres, the total lumber cut in 1946 was 261,514,000 board feet. The peak of production was reached in 1937 when the cut was approximately 563,000,000 board feet. Idaho has stands of about 12,000,000,000 board feet, and Washington about 2,000,000,000 board feet. These two states with Oregon and Montana are practically the sole source of this timber. Stands of 20,000 to 40,000 board feet to the acre are not uncommon, while a large area in Idaho yielded 40,000 board feet to the acre at 100 years of age, and another area about 150 years old cut 51,000 board feet to the acre. It is used widely for structural purposes, window and door frames, molding, matches, and pattern stock.

Western white pine develops greatest size and highest economic importance in deep porous soils on gentle north slopes and flats in northern Idaho and Montana. It seldom grows in pure stands and is most frequently associated with Western hemlock, Douglasfir, the several western firs and lodgepole pine. Deep snowfall, a mean annual precipitation of fifteen inches in California to sixty inches near Puget Sound, and a comparatively short growing season characterize the regions where this pine grows.

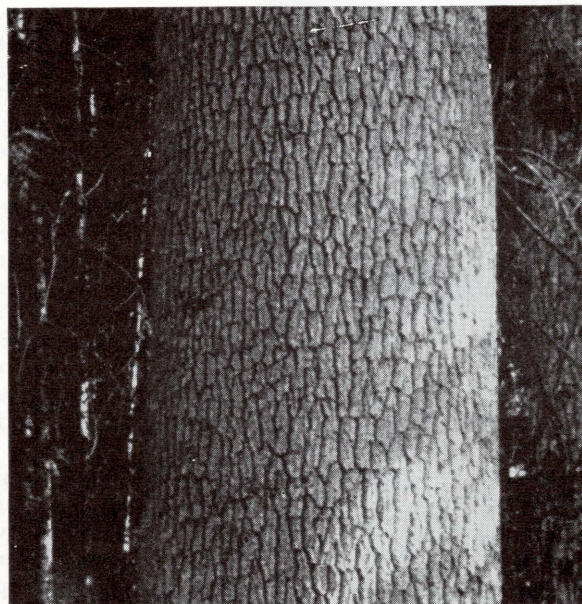
While subject to disastrous losses from fire, protection against which is essential, its most dangerous enemy is the white pine blister rust. This fungus disease, first reported on the West Coast in 1910, has made serious inroads upon scattered stands of young growth as far south as California. The fungus must find opportunity to live for a period upon the leaves of currant and gooseberry bushes before going over to the white pines, and cannot live where either the white pine or currant-gooseberry hosts are absent. Accordingly vigorous efforts are being made by the federal government, supported by the states and private landowners, to control the disease by destroying all the bushes in localities where the white pine is of commercial value.

The mountain pine bark beetle, *Dendroctonus moniticolae*, is the principal insect enemy and causes losses amounting to thousands of dollars each year. Control can be secured by felling the infected trees, peeling the bark and burning it. It is subject also to other pests common to Eastern white pine, but no others are of special significance in its natural range.

David Douglas, the Scottish explorer and botanist, first reported Western white pine on the slopes of Mount St. Helens in Washington in 1825. Soon after, seeds were sent to England, where the tree grows successfully. Because of its extreme hardiness, attractive color, compact pyramidal form and rapid growth during the first years, it is highly desirable for ornamental purposes. Not only is it widely used on estates and home grounds in the northwestern states, but it has proved hardy in New York and as far north as Ottawa, Ontario.



Pale bluish green needles in bunches of five and slender, cylindrical cones six to ten inches long are characteristic features of this pine



The bark is sharply broken into rectangular blocks and may vary from silvery gray to a grayish purple, or a rich cinnamon color



Natural range of Western White Pine in the United States

Sequoia sempervirens, (Lambert) Endlicher



THE redwood, whose family covered most of the northern hemisphere before the glacial periods, is now confined to an area of less than 1,500,000 acres. It grows in an irregular strip scarcely thirty-five miles wide and 500 miles long, extending along the west slope of the Pacific Coast from the Chetco River in southwestern Oregon to Salmon Creek Canyon, about one hundred miles south of San Francisco in Monterey County, California. The trees grow from sea level to approximately 3,000 feet above the sea, on flats and seaward slopes subject to frequent, heavy fogs.

The redwood and its close Sierra relative, the giant sequoia, [*Sequoia gigantea*], are the largest, and probably the oldest, examples of life in North America, if not in the world. Lambert, of London, published the first description of redwood in 1803, under the name *Taxodium sempervirens*, in the belief that it was related to the southern cypress. In 1847, believing it to be a distinct genus, the name *Sequoia* was given by a German botanist, Endlicher, to honor the half-breed Cherokee chief Sequoyah who formulated an alphabet for his tribe, and *sempervirens* is from the Latin, meaning "always green," sometimes interpreted "ever living."

Although not as long-lived as the bigtree nor as great in girth, it grows to a greater height than any other American tree. On flats under good conditions it grows to be 350 feet high and from twenty to twenty-seven feet in diameter. The oldest redwood found during investigations by the Forest Service was twenty-one feet in diameter and 1,373 years old. Another tree fifteen feet in diameter and 270 feet high, described by Prof. W. R. Dudley was 2,171 years old. Accurate ring counts cannot be secured without destroying the tree, but it is assumed that redwoods 300 feet high and twenty feet or more in diameter may approach an age of 2,000 years. Most of the redwoods cut in commercial operations are from 400 to 800 years old. These are from three to ten feet in diameter, and 200 to 275 feet tall. The tallest measured tree is 364 feet high and stands on Dyerville Flat.

The larger trees have a straight, slightly tapered, heavily buttressed trunk, clear for more than one hundred feet, with an open round-topped crown of relatively short horizontal branches spreading with a downward tendency. The crowns may occupy a third to a half of the total length. Those of young trees ten to fifteen inches in diameter are narrowly conical and may extend to the ground.

The sharply pointed, flat, bright, deep yellow-green leaves of the lower branches and young saplings stand out stiffly on opposite sides of the twigs and vary from one-third of an inch to an inch in length, while on the main stem of the branches they may occur as several overlapping lines of closely pressed scale-like forms. The leaves of each season's growth may remain on the tree for three or four years, and then cling to the branches for another one or two years after they are dead.

Tiny male and female flowers are on different branches of the same tree. The flower buds form in the autumn near the ends of the previous year's shoots. In the late winter or early spring the staminate flowers develop as small greenish yellow bodies in the axils of the leaves, while the more broadly egg-shaped ovulate flowers are terminal.

By early September of the same year the ovulate flowers mature into dull, purplish brown, egg-shaped cones about an inch long, and half as broad. Closely packed under each cone scale are four or five small russet brown, wing-margined seeds which are shed slowly, and carried comparatively short distances by the wind. They are about one-sixteenth of an inch in diameter and when clean will run about 123,000 to the pound. The cones remain on the trees several months after losing their seeds.

Rearing its crown to heights of over 300 feet, the coast Redwood of California is the taller and more graceful of the two species of *Sequoia*

The dull red-brown bark of old trees has a grayish hue and is longitudinally fissured. It is very dense and tight, may be a foot thick, and is highly resistant to fire. Beneath this is a firm, thin, cinnamon-red layer of more closely pressed bark.

Redwood is named for the soft, straight-grained, moderately strong heartwood which varies in color from a light cherry to a dark mahogany, and also for the color of the bark. The narrow sapwood is almost white. Air-dry heartwood weighs twenty-four to twenty-six pounds to the cubic foot. This is similar to the weight of the wood of northern white pine, to which it compares favorably in strength and stiffness. The wood is several pounds heavier than that of the giant sequoia and is stronger. It is easy to work, shrinks and swells but little, takes paint well, and resists decay and insects. Railroad ties, bridge timbers, tanks, flumes, silos, bee keepers' supplies, posts, grape stakes, shingles, siding, ceiling, doors, general mill work, caskets and furniture are among its many uses.

Recent estimates place the stand of redwood at 38,114,000,000 board feet. In 1909 there was estimated to be over 100,000,000,000 board feet and in 1931, 57,000,000,000 board feet. For 1946, a lumber cut of 230,000,000 board feet was reported — but in 1944 the cut was 461,000,000 board feet. Individual acres yielding over 100,000 board feet of sawtimber are very common, and some acres of unusually large trees are reported to have produced a million board feet.

Although many seeds are produced nearly every year only fifteen to twenty-five percent are perfect and the germination is low. Even so, millions of seed germinate and supplement the many vigorous sprouts which are produced from the stumps, root collar and roots of old as well as young trees. The "Muir Woods" near the base of Mt. Tamalpais, about 38,000 acres in state parks, and a growing sense of public responsibility among redwood timberland owners give assurance that considerable areas may be saved for future generations.

None of the ordinary wood-rotting fungi grow in redwood timber and the tree is singularly free from fungus diseases. A so-called brown rot takes heavy toll of the standing timber. This causes portions of the butt to assume the properties of charcoal and to crumble into a fine powder. Another stringy type of fungus does some damage. Similarly, few insects cause material harm and the wood is highly resistant to attacks of termites. Even fire does relatively little damage to trees which have acquired a thick bark, but the young growth is killed or seriously injured. The frequent "goose pens" in the larger trees are evidence that persistently repeated fires will make inroads upon them, and at the same time, of the amazing ability of the tree to maintain life, by healing over injuries wherever living tissue remains.

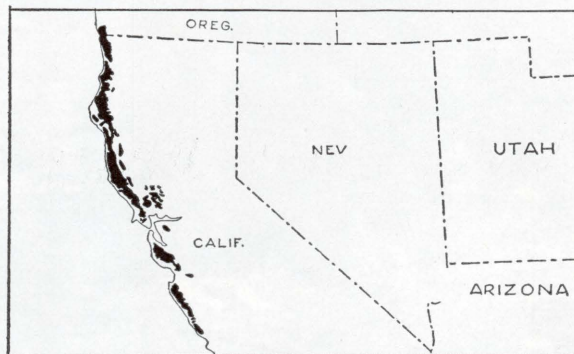
Redwood requires a moist, cool climate of high humidity as shown by its dependence upon the Pacific Coast fogs. It seldom thrives in a dry or warm climate, but will stand temperatures ranging from 15 to 110 degrees Fahrenheit. The best stands are on protected flats and benches along streams or on moderate west slopes opening toward the sea. Thirty to sixty inches of rain falls in the autumn and winter and sea fogs bathe the region in summer. It grows in mixture with Douglas-fir, tanoak, Sitka spruce, Port Orford white cedar, Western redcedar, white fir, and western hemlock. Where conditions are favorable the redwood leads all of these in the struggle for growing space. Efforts to grow redwood in the eastern states have met with little success.



The bright yellow-green leaves of the lower branches stand out stiffly on opposite sides of the twigs and remain on the tree three or four years. Those on the main branches are scale-like. The egg-shaped cones are scarcely an inch long, about half as broad and mature in a single season



Redwood bark is reddish gray in color, fibrous in texture and gives a fluted appearance to the tree



The natural range of Redwood is limited to a narrow strip extending along the Pacific Coast from southwestern Oregon to about 500 miles into California

ENGELMANN SPRUCE

Picea engelmanni, Parry



THE narrow pyramidal deep blue-green crown of Engelmann spruce is a feature of the high Rocky Mountains from the Yukon territory to Arizona. In the western Cascade Mountains of Oregon and Washington it grows at elevations of around 6,000 feet, and at steadily increasing elevations as the range extends into Arizona and New Mexico, where it is found from 8,500 to 12,000 feet above sea level. As a rule it finds sufficient soil moisture only at higher elevations, so its lower range is limited to moist canyons and north slopes. In dense stands Engelmann spruce has a straight, slightly tapering trunk and a fairly short, narrow pyramidal crown of small branches. The lower branches droop and when grown in the open extend to the ground. Numerous tassel-like side branchlets hanging from the main horizontal branches give a compact appearance to the crown. Trees attain heights of eighty to 110 feet, with diameters at breast height from eighteen inches to thirty-six inches, and clear trunk lengths of twenty-five feet. Such trees may be 500 to 600 years old. At high altitudes exposed to wind and low temperatures, trees two to four feet high with slender, spike-like stems may live for 100 years or more.

The deep blue-green leaves or needles are an inch or more in length, four-angled, more or less directed forward, rather soft and flexible to the touch with a relatively short, flat point. On young trees and on those which do not bear cones, the needles are spreading and evenly scattered, while on the cone-bearing twigs they are commonly crowded and usually shorter. Ordinarily deep blue green, some trees are decidedly silvery. This is particularly true of the younger trees. The young shoots, which are covered with fine hairs for the first three years, and the leaves, give off a disagreeable odor when crushed. These features, together with the smaller cones, help distinguish it from the Colorado spruce, *Picea pungens*.

The dark, purplish brown or russet-red bark is one-quarter to one-half an inch thick, and broken into thin, loosely attached, small scales. Even young trees have the characteristic scaly bark.

In the spring each tree carries dark purple male flowers, and bright scarlet female flowers, like little catkins, near the top of the tree. The latter develop by the following August into cylindrical light brown cones, an inch to three inches long. The small, dark brown, winged seeds are soon shed and by early winter the empty cones drop from the trees. Large crops of seed are borne at intervals of three or four years from the time the tree is about twenty-five years to an advanced age. While the crops are heavy and seeds which lie protected in the forest duff continue to be fertile for four or five years after being shed, natural reproduction is usually sparse.

The deep blue green spires of the Engelmann Spruce dominate the landscape of the higher western Rockies from the Yukon territory to Arizona

The light yellowish or faintly reddish brown wood is fine-grained and lighter in weight than white pine. A single cubic foot when air dry weighs about twenty-three pounds. It is strong for its weight, and carefully selected spruce lumber was used in the early airplanes. It is used locally for telephone and telegraph lines, and also for doors, window sash and interior trim.

Picea is the Latin name for spruce and is derived from *pix*, meaning pitch, while *engelmanni* refers to George Engelmann, a distinguished botanist of St. Louis, Missouri, whose identifying description of this spruce first appeared in 1863.

It is the most important of the Rocky Mountain spruces, and the sawtimber stand has been estimated at 29,000,000,000 board feet, nearly half of it in Colorado. The Engelmann spruce lumber cut for 1946 amounted to 64,400,000 board feet. It is cut chiefly in Colorado, Montana and Idaho, with comparatively small amounts in Wyoming, Utah, Washington and New Mexico.

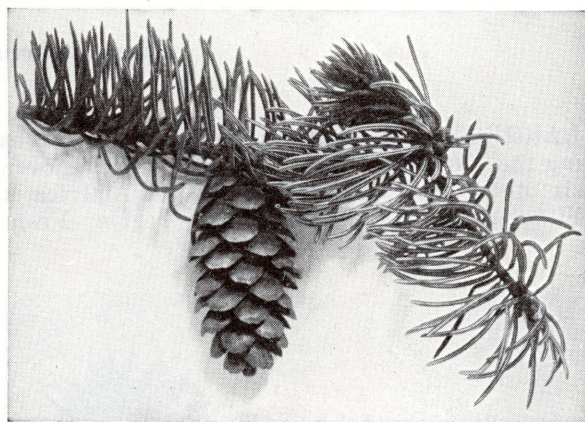
While Engelmann spruce grows at the upper limits of tree growth, varying from 6,000 feet above sea level in the north to 12,000 feet in the south, with variations according to local climatic conditions, the merchantable sizes are found at the middle and lower levels. Even these are relatively high elevations, however, and the resulting inaccessibility is the chief reason for its minor commercial importance.

Within its range it is frequently the dominating species and is commonly associated with alpine fir, white fir, lodgepole pine, limber pine and Douglasfir. In the north it may also be found with Western white pine and in the south with corkbark fir. Because it surpasses most of its associates in its tolerance of shade, the forest invariably contains Engelmann spruce of all ages and sizes, varying from seedlings and saplings to trees of sawlog size. These are more tolerant in youth than in old age, but the small suppressed growth shows remarkable ability to respond after it has been released by the removal of larger trees. Even after years of shading, trees will make good growth after the source of suppression is removed.

Fortunately the season of great fire hazard at high elevations is relatively short, but once started, fire is almost impossible to control when it gets into the heavy crowns of this spruce. Fire, as well as extensive timber cutting, may be followed by considerable windfall because of the shallow root system.

Engelmann spruce has few insect or fungus enemies, but is susceptible to the spruce budworm. Control under the mountainous forest conditions would be difficult, but thus far the attacks have never been extensive.

Although native to the high western mountains, it can adapt itself to eastern conditions and has been successful as an ornamental tree on northern exposures in relatively moist clay loam soils, but cannot stand the hot dry winds of open prairies. The singular beauty of color and form makes it increasingly favored for landscape purposes. Probably first cultivated in the Arnold Arboretum, it has been introduced successfully into England and parts of Germany. The lower branches are maintained for forty or fifty years, and while the tree loses symmetry with age, it is always beautiful.



The soft, flexible, four-angled needles are an inch or more long and usually curved forward, while the light brown cones are one to three inches long



Many small, thin, loosely attached scales are laid one over the other to form the thin, russet-red bark



Natural Range of Red Spruce
United States

SITKA SPRUCE

Picea sitchensis, (Bongard) Carrière

LARGEST of the eighteen species of *Picea* inhabiting the Northern Hemisphere and towering over the six other spruces occurring in North America is the Sitka spruce of the North Pacific region. From sea

level to elevations of 3,000 feet, it occupies a narrow coastal ribbon forty to fifty miles wide and some 2,000 miles long from Mendocino County in northern California to the east end of Kodiak Island in Alaska.



Courtesy "Forest Trees of the Pacific Slope" by W. A. Elliot
Sitka towers above all other spruces, and even open grown trees reach heights of 160 feet

Ranking with redwood and Douglasfir, Sitka spruce is one of America's fastest growing conifers. Heights of over 200 feet have been attained in 100 years, yet it may live 800 to 850 years. Trees are ordinarily eighty to 125 feet high and three and a half to six feet in diameter, but heights over 280 feet have been recorded, and in low, wet valleys and flatlands, they reach 160 to 200 feet with diameters of eight to ten feet above the buttressed base. The swollen buttresses of the long clean trunks and the protruding roots help distinguish Sitka spruce from associated redwoods, Western redcedars, lowland firs, and yellow cedars, as well as the smaller Pacific yew and black hemlock with which it is frequently associated. It also grows in company with Douglasfir, broadleaf maple, vine maple, alder, black cottonwood, and willows. To the north and in Alaska it forms pure stands or includes western hemlock, but in the extreme Northwest where it extends beyond all other conifers, it is reduced to a low shrub.

In dense stands it is clear of branches for forty to eighty feet with a thin, open conical crown of small branches. Open grown individuals seldom attain the height of those in the forest and the rapidly tapering trunk is clothed to the ground with huge sweeping branches.

Sitka spruce is unique among American spruces in having thick, flattened leaves, the four angles of which are indistinct. They grow on smooth stems and are bright bluish green, half an inch to a little over an inch long, keenly pointed and with broad silvery bands of stomata usually confined to the lower surface. In the tops of tall trees the leaves are thicker, more crowded, and with stomata marking the upper surface. The prickly needles stand straight out around the branch.

Dark red, pollen-bearing flowers adorn the ends of the drooping side branches in early spring, while high up on stiff terminal shoots are the

short-stalked oval female cones. A single growing season matures these as pale yellow or reddish brown, flexible cones two to four inches long, which hang conspicuously on the pendulous branches. They ripen in the early fall, and from their thin, papery, oval scales, whose margins are unevenly toothed, are shed tiny, clay-brown winged seeds. Heavy crops of fertile seed may occur every two to three years. They will grow on any wet or constantly moist soil, but for the first few years the seedlings are sensitive to frost.

Deep reddish brown or dark purple bark, with the surface broken into large, thin, easily detached scales, clothes old trunks to a thickness of about half an inch. On branches and trunks of young trees the bark is scaly and dark grayish brown, while the dark yellow-brown twigs are smooth.

Without odor or taste, the pale pinkish brown wood is soft, straight grained and light—a cubic foot weighing about twenty-five pounds when air dry. It works easily and the planed surfaces have a silky sheen. Remarkably strong for its weight, it is easily kiln dried and shrinks and swells only moderately.

It was used during both World Wars in airplane construction, but the bulk of the 150,000,000 board feet cut in 1946 was chiefly for boxes and crates, furniture, planing mill products, doors, blinds, sash, and general mill work. The annual consumption of about 110,000 cords for pulp indicates its excellence for the manufacture of paper. Small quantities of slowly grown, highly resonant timbers are specially selected for piano sounding boards.

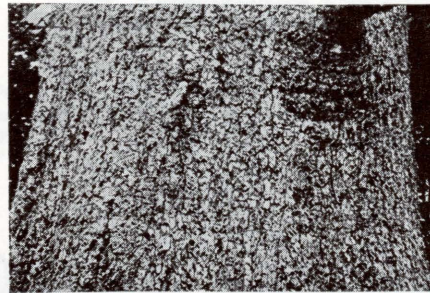
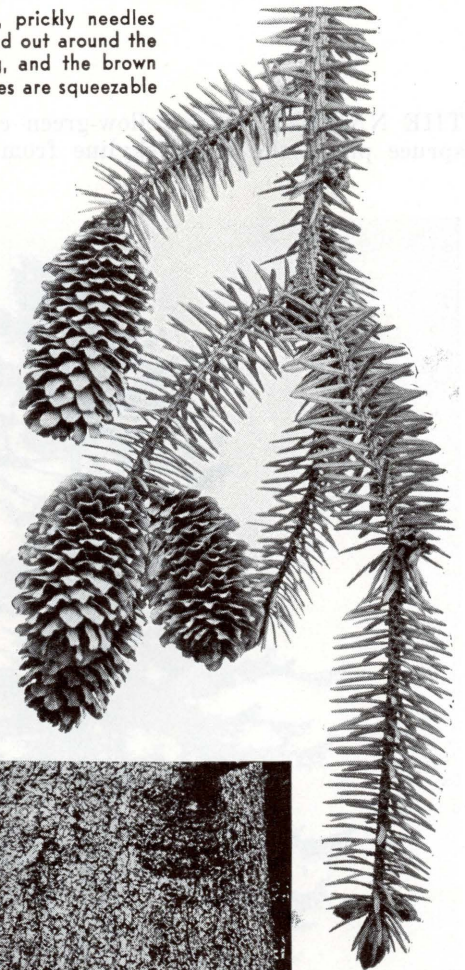
The stand of Sitka spruce in the United States is estimated at 7,000,000,000 board feet, nearly all in Washington and Oregon. The stand in Alaska has been estimated at 15,000,000,000 to 18,000,000,000 board feet and in British Columbia at 15,000,000,000 board feet.

While the thin bark leaves individual Sitka spruce easy victims of fire, the humidity of its coastal range partly protects old stands from severe damage. Organized fire protection during the two or three dry summer months is, however, essential to the natural reproduction that follows logging. It is frequently harmed by one of the bark beetles, and is defoliated by the Douglasfir chermes. Although attacked by two rust diseases, and by several wood rotting fungi, this spruce is more free from decay than either Douglasfir or Western hemlock.

Archibald Menzies, a distinguished English traveler, is credited with its discovery on Puget Sound in 1792. For a time it was known as Menzies spruce, *Picea menziesii*, but botanists now accept the geographical name, *Picea sitchensis*, in which the French botanist Bongard recognized the heavy stands of this tree in the vicinity of Sitka, Alaska.

Sitka spruce demands a cool, humid climate and is successfully grown for forest as well as ornamental purposes in England and western Europe, where it was introduced by Douglas in 1831. It is less adapted to our Middle Atlantic States, while the hot, dry summers of New England and the eastern states have proved too severe, unless the trees are watered or heavily mulched.

Flat, prickly needles stand out around the twig, and the brown cones are squeezable



The reddish brown scaly bark is about half an inch thick

Courtesy "Forest Trees of the Pacific Slope" by W. A. Elliot



Natural range of Sitka Spruce

RED SPRUCE

Picea rubens, Sargent

THE NARROW, dark yellow-green crowns of red spruce pierce the forest skyline from southeastern

Canada through New England, eastern New York and the Appalachian Mountains to Georgia. Frequently in mixture with white pine, hemlock, balsam fir, sugar maple, yellow birch, or beech, pure stands are usually limited to swamps and mountain tops. In its northern range, red spruce grows on well-drained soils near sea level, but ascends in the Adirondacks to altitudes of 4,500 feet and in the Southern Appalachians is seldom found below 5,000 feet.

Red spruce of the North reaches heights of sixty to eighty feet, with trunk diameters of nearly two feet. Larger sizes are attained in the Southern Appalachians with occasional trees over one hundred feet high and up to four feet in diameter. Some botanists classify these southern mountain spruce as *Picea australis*. The crown of red spruce is less regularly symmetrical than that of most other spruces, and with maturity becomes open and widespreading. Numerous large, irregular branches droop as they extend outward, before turning up at the tips.

The plump, four-sided, dark, shiny, yellow-green needles are about half an inch long and grow singly from all sides of the twigs and branches. They are slightly incurved, usually blunt-pointed, and have a prominent midrib on the lower surface. They remain on the twigs about six years. A reddish coat of down persists on the slender new twigs through the first year. This, together with the short incurved needles helps distinguish red spruce from all but black spruce whose needles are more nearly blue-green, and without the midrib on the lower surface.

Bright red, oval, pollen-bearing staminate flowers about half an inch long grow close to the twig near the ends of the previous year's growth in April and May. The ovulate flowers appear simultaneously but on the ends of different branches of the same tree. They are



Devereux Butcher

The open, widespreading crown of Red Spruce reaches heights of sixty to one hundred feet

reddish green, oblong, cylindrical cones about three quarters of an inch long. Standing erect at first, they hang down after being fertilized, and in the autumn of the same year mature as elongated egg-shaped cones one to two and a half inches long. Purplish or light green during the spring and early summer, they become a light, glossy, reddish brown when ripe. The rounded, entire margins of the scales help distinguish these cones from those of black spruce. Also, the cone scales are thicker and less flexible than those of white spruce. The dark mottled brown seeds are shed through fall and early winter, and the cones drop by the end of the following year. The seed are about an eighth of an inch long, and with the full rounded wing are nearly half an inch long.

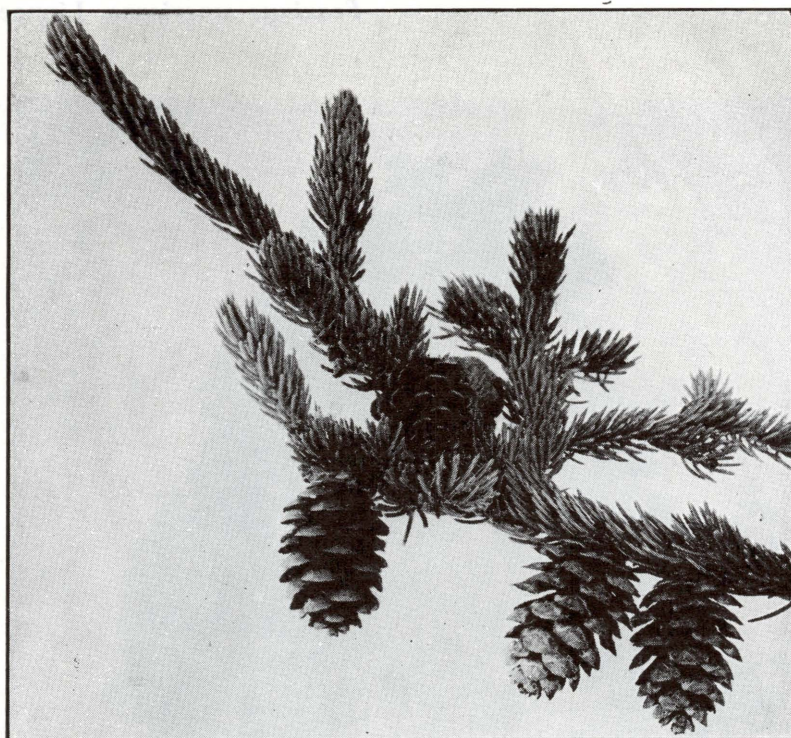
The red cones are responsible for the name *rubens* applied to the species by Sargent.

Old trunks have dark, reddish brown bark often appearing as if washed with gray. It is hard, firm, and about half an inch thick.

The light, soft, narrow-ringed wood is faintly tinged with red, but a layer of sapwood often two inches thick is almost white. Averaging about twenty-eight pounds to the cubic foot when air dry, the wood is easy to work, free from pitch or distinctive flavor, and holds paint fairly well. The combination of strength and stiffness in relation to weight gives spruce a special place in the construction of ladder rails, canoe paddles, and light oars, but the long straight fibers and light color favor it for the manufacture of paper. Spruce furnishes a large part of the pulpwood for American paper manufacture. The production of domestic eastern spruce pulpwood in 1944 was 2,000,000 cords. Probably two-thirds was red spruce. The average annual lumber cut of eastern spruce is about 121,000,000 board feet. The sawtimber stand of red, white and black spruce in the United States is about 20,000,000,000 board feet, possibly eighty percent of which is red spruce. The Canadian supply of the several spruces is not only greater but of better quality.

Fire is the worst enemy of spruce. Fortunately, however, its preference for damp situations usually retards a real conflagration. Occasionally, the heavy accumulation of debris becomes dry and fires sweep into the dense crowns with disastrous results. Less spectacular ground fires are especially damaging to the young growth.

Of the many insects which prey upon the foliage, bark, wood, and twigs of spruce, the European spruce sawfly is the worst.

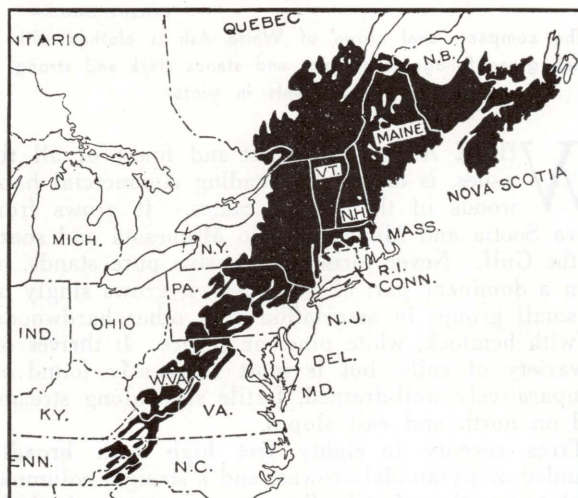


Devereux Butcher

Glossy red-brown cones emerge from last year's dark yellow-green needles



The dark reddish brown bark of mature trunks is hard and firm, often appearing as if washed with gray



Natural Range of Red Spruce

Fraxinus americana, Linnaeus



George J. Baetzhoid

The compact, oval crown of White Ash is clothed with rich green foliage in summer and stands stark and strong against the elements in winter

WHITE ASH, the largest and finest of all the ashes, is one of the leading commercial hardwoods of the United States. It grows from Nova Scotia and Maine, west to Minnesota and south to the Gulf. Never forming extensive pure stands, or even a dominant part of the forest, it grows singly or in small groups in association with other hardwoods, or with hemlock, white pine, or spruce. It thrives on a variety of soils, but is most frequently found on comparatively well-drained, fertile sites along streams and on north and east slopes.

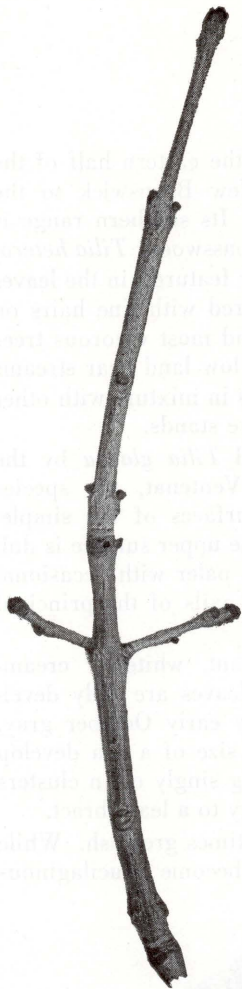
Trees seventy to eighty feet high with broadly rounded or pyramidal crowns, and a straight columnar trunk two to three feet in diameter are common through-

out much of its range, but the giants of one hundred and twenty feet in height and six feet in diameter were largely confined to the deep, moist soil of fertile bottomlands in the lower Ohio River Valley. In the forest the straight, symmetrical stem may be clear of branches for more than half the total height of the tree.

Like the other members of the olive family, *Oleaceae*, of which American ash is the chief commercial lumber species, the branching is opposite. The pinnately compound leaves are eight to twelve inches long, with five to nine short-stalked dark green, pointed leaflets, each three to five inches long and one to two inches broad. They are pale green or silvery white and smooth underneath, with only the semblance of teeth on the edges.



George J. Baetzhoid



Sturdy twigs and dark rounded buds help identify the white ash in winter

The inconspicuous, dark reddish to purple, four-lobed male blossoms are produced on different trees from the clusters of pistillate ones. Occasional trees produce perfect blossoms. They open before the leaves late in April or May, and the pistillate ones develop by mid-summer into long, drooping clusters of light brown, paddle-shaped fruits, one to two inches long, in which the narrow pointed seed case extends lengthwise to form a wing about a quarter of an inch wide.

Ash may get its name from the dark brown, ashy gray bark which is one to three inches thick, and deeply divided by narrow diamond-shaped fissures into flattened ridges. The thick opposite branchlets are first dark green or brown and covered with scattered hairs, but later become smooth, ashy gray and marked with pale lenticels or breathing pores.

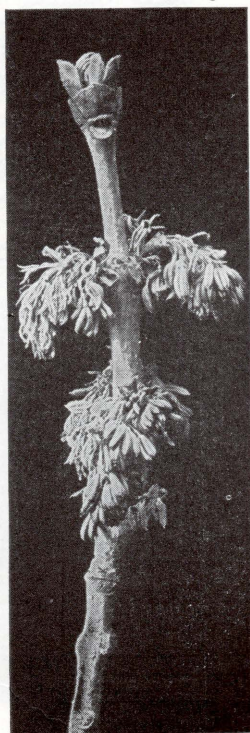
Fraxinus is the classical name for ash, while *americana* singles this outstanding American variety from nearly fifty species distributed over the temperate and tropical regions of the northern hemisphere. Eighteen species of ash are recognized in the United States.

The hard, close grained, light brown wood is strong, tough, elastic, and free from taste or odor. When air dry it weighs about forty-two pounds to the cubic foot. It is used for tool handles, butter tubs, oars, sporting goods, furniture, vehicles, and interior trim.

The total stand of the several species of ash is estimated at 8,000,000,000 board feet, and consists largely of second growth in small timber tracts and farm woodlands. In 1909 the production of ash lumber reached a peak of 291,000,000 board feet, but in 1946 the cut was only about 133,000,000 board feet. Probably at least 40 percent of the present cut is white ash.

It is relatively free from insect and fungus attack, but the thin-barked young trees are highly susceptible to fire damage. Ash reproduces sparingly from seed, but because of its high stumpage value it is generally encouraged in farm woodland management. Young trees produce vigorous sprouts, but the chief source of reproduction is by seeds.

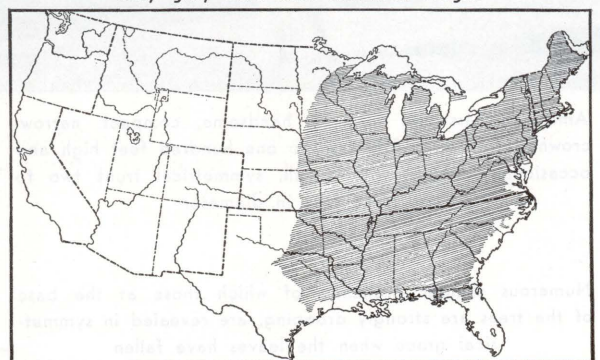
Tufts of dark red to purple staminate blossoms appear in early spring before the leaves



White ash leaves are pinnately compound with five to nine short-stalked leaflets, while light brown paddle-shaped fruits one to two inches long, hang in clusters from the previous year's growth



Deep diamond-shaped fissures cut the ashy gray bark into flattened ridges



Natural range of White Ash in the United States

AMERICAN BASSWOOD

Tilia americana, Linnaeus

THE AMERICAN BASSWOOD, American linden, or lime, forms a compact, symmetrical tree usually seventy to ninety feet high with a trunk two or three feet in diameter. Occasional trees 140 feet high with maximum trunk diameters of four and one-half feet have been reported.



American Basswood forms a handsome, compact, narrow-crowned tree from fifty feet to one hundred feet high and occasionally higher, with a full, symmetrical trunk two to three feet in diameter

Numerous slender branches, of which those at the base of the trees are strongly drooping, are revealed in symmetrical grace when the leaves have fallen

It is distributed over much of the eastern half of the United States and north into New Brunswick to the eastern shores of Lake Superior. Its southern range is confused with that of the white basswood, *Tilia heterophylla*, which differs, among other features, in the leaves which are silvery white and covered with fine hairs on the lower surface. The largest and most vigorous trees are found in fertile coves and on low land near streams within the central states. It grows in mixture with other hardwoods and does not form pure stands.

This tree was formerly named *Tilia glabra* by the French botanist Etienne-Pierre Ventenat, the species name referring to the smooth surfaces of the simple, alternate, heart-shaped leaves. The upper surface is dull dark green, and the lower surface paler with occasional tufts of rusty brown hairs in the axils of the principal veins.

The perfect five-petaled, fragrant, white or cream-colored flowers appear after the leaves are fully developed in June and early July. By early October gray, woody, spherical fruits about the size of a pea develop from the fertile blossoms and hang singly or in clusters from a stalk attached about midway to a leafy bract.

The buds are dark red or sometimes greenish. While without distinctive flavor, they become mucilaginous



when chewed. The dark gray bark of old trees is about an inch thick, deeply furrowed into narrow, flat-topped firm ridges with characteristic horizontal cracks. That of young trees is gray, smooth and thin. The bast fibers of the inner bark have long been used in making cords, fish nets, mats and similar articles.

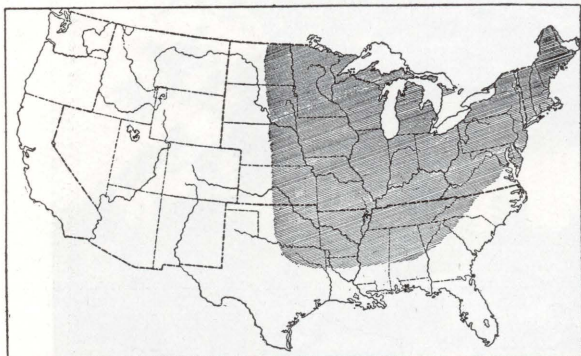
The white to creamy brown wood is valued for its white color, light weight and good working qualities and is used widely for wood-ware, slack cooperage, boxes, veneer, excelsior, paper pulp, and many small articles. When air dry it weighs about twenty-six pounds to the cubic foot.

The stand of basswood in the United States has been estimated at 4,000,000,000 board feet, about one-half of which is in the Lake States. The basswood lumber production for 1946 was about 155,000,000 board feet. West Virginia and Kentucky together furnish nearly one-third, and Wisconsin and Michigan another third of the total cut. The peak in basswood lumber production was in 1909 when the cut reached 400,000,000 board feet.

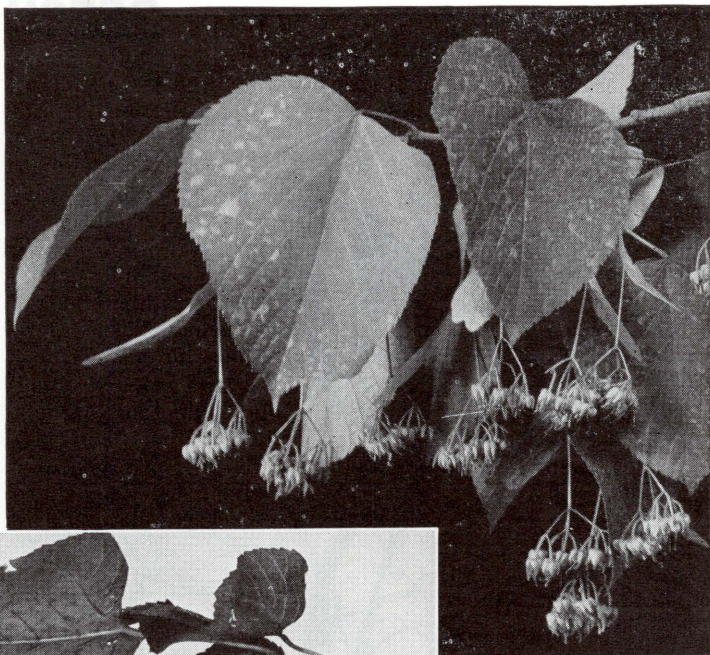
It grows rapidly, develops from stump sprouts as well as from seeds. Trees mature at from ninety to 140 years, and when crowded by other trees form straight stems with clear lengths of fifty to seventy feet.

While the leaves are frequently disfigured by insects, the tree seldom succumbs to their attacks. Fire often causes hollow butts and permits the entrance of wood-destroying fungi.

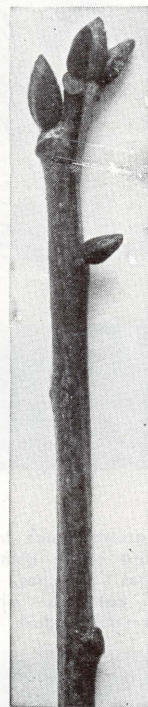
Throughout eastern United States basswood adapts itself to difficult conditions and is frequently recommended for city streets. It is also satisfactory on the Pacific slope.



Natural range of Basswood in the United States



The broad, heart-shaped leaves are smooth on the under as well as the upper surface, bear coarse teeth on the margins and taper rapidly to a point. Scarcely have the leaves fully formed when clusters of white or creamy five-petaled perfect flowers appear suspended from a leafy bract (upper picture). By early autumn many of these have developed into woody fruits (lower picture) about the size of a pea. Without a true terminal bud, the smooth dark red, or sometimes greenish, lateral buds are about a quarter-inch long and are arranged alternately on the twig (right)



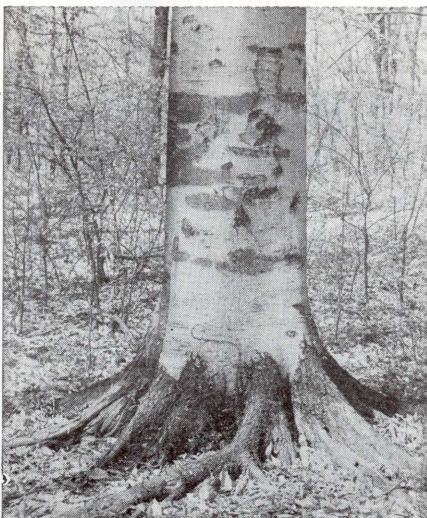
The furrowed bark is about an inch thick

Fagus grandifolia, Ehrhart



Devereux Butcher

Open grown Beech trees have a low wide spreading crown comprised of many long horizontal branches. The smooth tight fitting bark is silvery gray touched with irregular dark blotches and bands



BEECH is native from southern Canada, northern Michigan and eastern Wisconsin to the Atlantic, and south to eastern Texas and northern Florida. Preferring deep, rich, well-drained soils, it grows wherever moisture is in the upper layers. It attains largest size, however, in the rich, alluvial bottomlands of the Ohio and the lower Mississippi River valleys, and along the western slopes of the Southern Appalachian Mountains. Here trees with trunks over four feet in diameter reach heights of 120 feet and are clear for sixty to seventy feet.

The glossy, blue-green, straight-veined leaves are simple and alternate on the twigs. They are three to five inches long and rather coarsely serrate with a vein terminating in each tooth.

Each tree bears separate male and female flowers. These appear in early spring when the leaves are half grown; the yellow-green staminate ones being about an inch in diameter, hanging from

long stems, while the pistillate ones are usually in pairs covered with many pointed bracts and supported on a short hairy stem.

By early autumn the short-stalked bur is ripe. Within, surrounded by a downy lining may be found two or three small triangular, highly polished, brown, sweet-meated nuts. These edible nuts are responsible for the classical Latin name *Fagus*, from the Greek, *phagus*, to eat; while *grandifolia* refers to the beautiful leaves. This tree reproduces by root sprouts as well as by seeds.

The smooth, close-fitting, blue-gray bark covers the trunk and branches like a skin. Seldom more than half an inch thick, it is frequently mottled with dark blotches and bands.

Beech wood is light red in color, heavy, hard, strong, close-grained, and difficult to split. A cubic foot when air dry weighs about forty-five pounds. It shrinks considerably in drying, is not durable when left in contact with the soil, but takes a high polish and wears well when subjected to friction under water. The wood is used for chairs and other furniture, flooring, railroad ties, woodenware, handles, novelties, and because of its clean odor for barrels and boxes in which to hold foods.

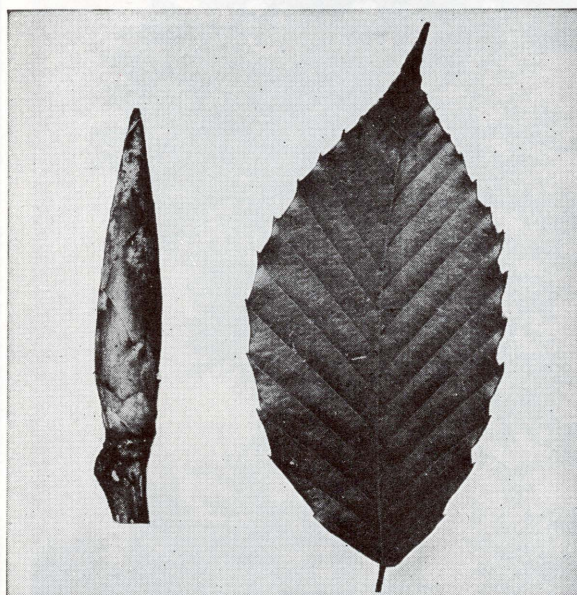
The estimated stand of 5,000,000,000 board feet of beech sawtimber in the United States is located chiefly in New England, New York and Pennsylvania. Beech lumber cut in 1946 amounted to about 440,000,000 board feet. Kentucky and Tennessee are the largest producers.

Of relatively slow growth, it may attain ages of 300 to 400 years. It is subject to several injurious insects and fungi, and the thin bark makes it an easy victim to ground fires.



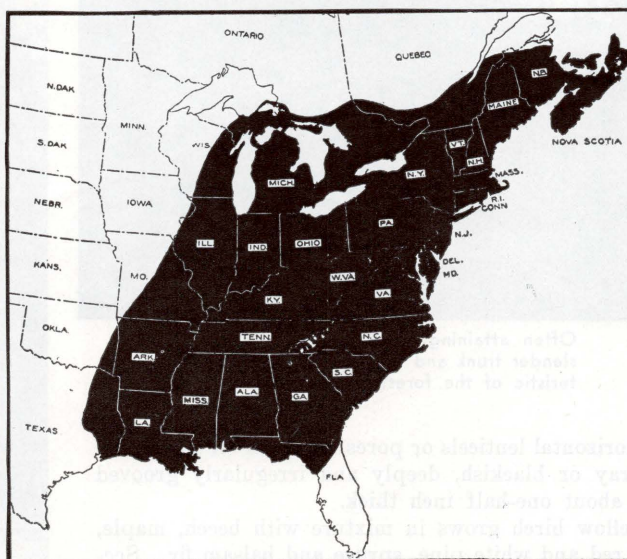
W. M. Harlow

The yellow-green staminate blooms appear when the leaves are still limp. Each leaf is three to five inches long with parallel veins terminating at the marginal teeth. The tapering bud is an inch long and polished brown.



W. M. Harlow

Natural range of Beech in North America



George J. Baetzhoid

The shiny triangular nuts are encased in a small prickly bur

YELLOW BIRCH

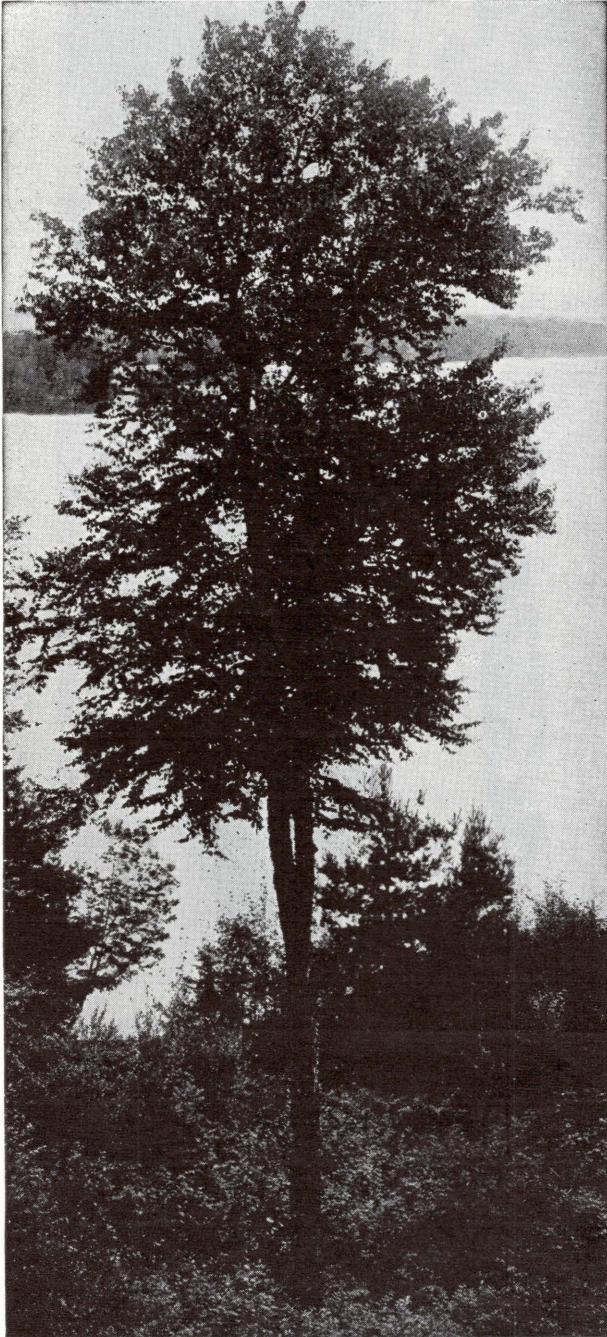
Betula lutea, Michaux

A LUSTROUS, silvery yellow bark on limbs and young trunks makes yellow birch easy to identify. Except on very young trees, the bark peels into thin, papery strips that give a ragged appearance. Marked

and growth forests sometimes contain limited areas of pure yellow birch, with straight, gleaming trunks.

In the open, trunks are usually short and divide into numerous large ascending limbs with slender, somewhat pendulous branchlets that form a broad open head. Under forest conditions trunks are tall and clear of limbs. Mature trees average sixty to seventy feet in height with trunks two or three feet in diameter. On preferred sites trees reach ninety or a hundred feet in height with trunk diameters of four feet.

The range of yellow birch extends from Newfoundland, Nova Scotia and the north shore of the Gulf of St. Lawrence west across Minnesota and eastern Iowa, and southward along the mountains to Georgia. A tree of rich, moist woodlands, its preferred sites are val-

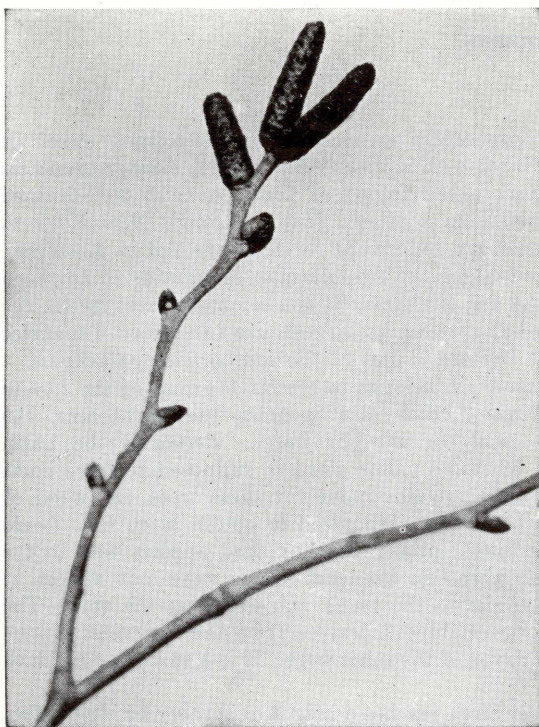


Often attaining large size, the straight, slender trunk and oval crown are characteristic of the forest-grown Yellow Birch

by horizontal lenticels or pores, the bark on old trunks is gray or blackish, deeply and irregularly grooved and about one-half inch thick.

Yellow birch grows in mixture with beech, maple, ash, red and white pine, spruce and balsam fir. Sec-





Devereux Butcher

During the winter, before developing into pendent catkins, the staminate aments are shiny chestnut-brown, and about three-quarters to an inch long



Devereux Butcher

Each scale of the cone-like fruit contains three winged seeds. Seeds and scales drop away in autumn leaving a central, erect core on the twig

leys and stream banks, although it adapts itself to higher ground, as in the mountains of New England where it reaches elevations of 3,000 feet.

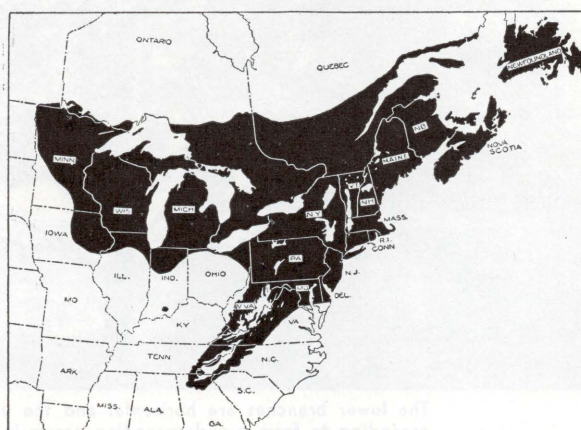
The twigs resemble those of sweet birch, but lack the strong wintergreen flavor of the latter. They are green and hairy at first, turning light orange-brown during the first summer, later becoming smooth and dark. Covered with three to eight scales which are downy on the margins, the winter buds are found only along the sides of the twigs—the terminal bud being absent. At the tips of the twigs the pendent staminate or pollen-bearing catkins are borne in clusters of two to four. At the sides of the twigs the solitary, stemless pistillate or seed-producing flowers appear, and by autumn develop into scaly seed-bearing cones about an inch in length.

Attached by short, grooved stems, the leaves are pointed, with sharply double-toothed margins, and have a wedge- or rarely heart-shaped base. Dull dark green above, they are yellow-green beneath with hairs on the veins, and measure three to four inches long and one and a half to two inches wide.

Yellow birch wood weighs forty pounds to the cubic foot when dry. It is hard, strong, and takes a satiny polish. Heartwood is light brown tinged with red, and the sapwood nearly white. Most abundant of all our native birches, the stand is estimated at 10,000,000,000 board feet which produced a lumber cut of approximately 145,000,000 board feet in 1946. It is used for furniture, packing boxes, button molds, wheel hubs, flooring, veneer, interior finish, woodenware, agricultural implements and many other purposes. Areas of greatest commercial abundance are Wisconsin, northern Michigan, New England, and New York.



The lustrous, silvery yellow bark on limbs and young trunks peels into thin papery curls



Natural range of Yellow Birch

SWEET BIRCH

Betula lenta, Linnaeus



L. W. Brownell

In the open the trunk is short, and the branches long and spreading, but in the forest, Sweet Birch is tall and slender and clear of limbs for a great height



The lower branches are horizontal and the upper ones steeply ascending to form a widespreading crown in open-grown trees

L. W. Brownell

THE gracefully symmetrical round-topped sweet or black birch with its nearly black bark, slender branches, and dark green foliage is found on rich well-drained uplands from southern Maine through New York to eastern Ohio, southward to Delaware and in a narrowing area along the Appalachian Mountains to northern Georgia and Alabama. It is a common forest tree in the north but reaches its largest size in eastern Tennessee on the western slopes of the southern Appalachians.

Sweet birch belongs to the birch group of the family *Betulaceae*, which also includes the hornbeams, the alders, and the shrubby hazel. *Betula* is the Latin name for birch. The word is supposed to have come from the old Gallic name for these trees, the wood of which the Gauls carbonized to obtain birch tar. *Lenta* means tough, pliant, bending, and applies well to the slender whip-like branches which grow out almost at right angles to the trunk and droop at the ends. The name "sweet birch" derives from the fragrant winter-green flavor of the inner bark. It is also known as black birch.

Sweet birch reaches a height of seventy or eighty feet with a trunk diameter of two to five feet. The bark on old trunks is one-half to three-quarters of an inch thick, dark reddish brown or almost black, furrowed, and broken into thick irregular plates. On young stems and branches it is smooth and shiny, marked with long horizontal narrow corky lenticels or pores. The twigs, pale green at first, change to dark reddish brown. As with all the trees in this family, no terminal buds are formed at the ends of the branches. The branches are prolonged by the uppermost slender sharp-pointed lateral buds. The leaves, growing alternately, often in

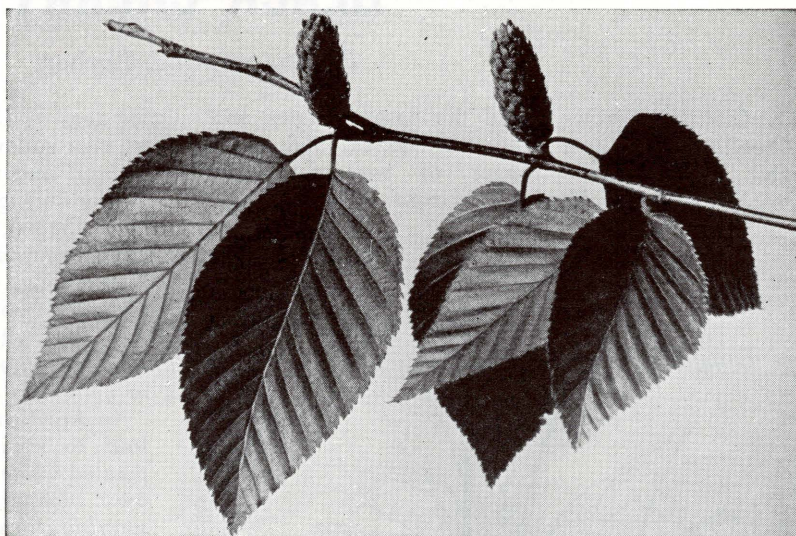
pairs, on the sides of the twigs, are more or less oval with an uneven, rounded or heart-shaped base, a tapering tip, and numerous sharp, slender, incurved teeth on the margin. They are two and a half to six inches long and one and a half to three inches wide. The upper surface is dark dull green and the under surface is pale yellow-green with conspicuous hairy primary veins and yellow midrib. Supported by stout, hairy stems, approximately an inch long and deeply grooved on top, the leaves turn a clear bright yellow in autumn.

The staminate catkins, about three-fourths of an inch long, form in the late summer, and remain on the tree through the winter. In

April, before the leaves come out these catkins open to three or four inches in length and are bright yellow at first, and later, when the pollen develops, greenish yellow. The pistillate catkins are pale green and little more than half an inch long, maturing into erect small-scaled cones, one to one and a half inches long.

The wood of sweet birch is strong, hard, heavy, close-grained, has high shock-resisting ability, and a cubic foot when dry weighs forty-eight pounds. The dark reddish brown heartwood is enclosed in pale yellow sapwood that is several inches thick. Its principal uses include general millwork, boxes, crates, spools, bobbins, novelties, woodenware, fuel, motor vehicle parts, and, because it takes a fine polish, it is also used for furniture. In smaller quantities it is used for pulpwood. Sweet birch is one of the most important hardwoods for distillation in the production of wood alcohol. Distillation of the wood, bark and twigs also produces oil of birch, a substitute for oil of wintergreen used for flavoring, while birch beer is made from the sap.

The worst enemy of sweet birch is the bronze birch



Devereux Butcher

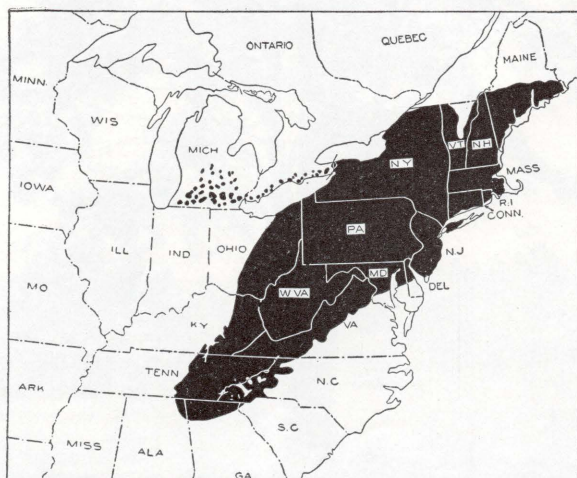
The leaves grow in alternate pairs along the sides of the twigs or singly near the tips, and the cone-like fruits grow from the base of the leaf stems

borer which tunnels between wood and bark and frequently kills trees by girdling. This pest is usually not prevalent in healthy stands of forest-grown sweet birch, but prefers old trees, trees on poor sites, and open-grown trees. Young trees are sometimes attacked by fungus.

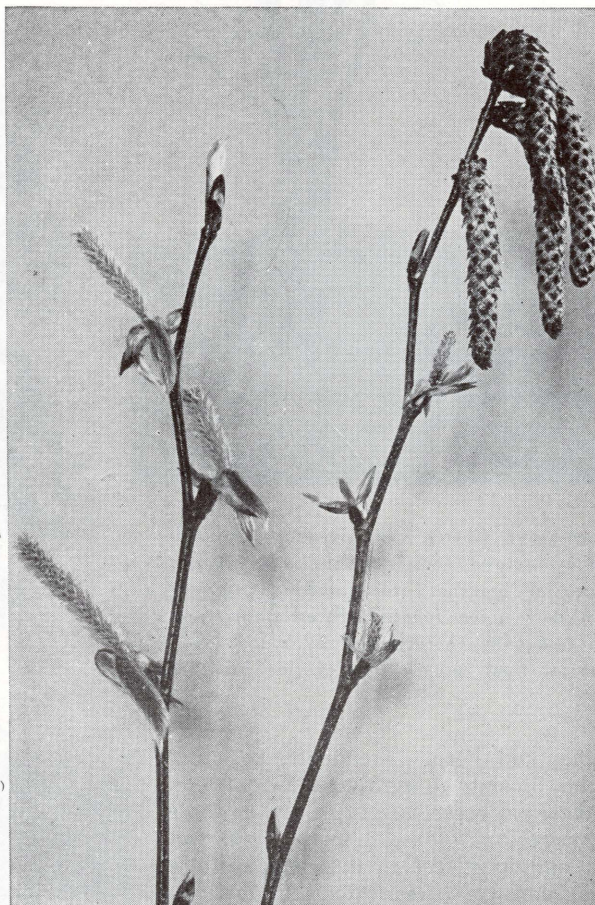


Devereux Butcher

Bark on the lower trunk of old trees is cracked into irregular scales, and on young trunks and limbs it is smooth, and has horizontal pores



Natural range of Sweet or Black Birch



Devereux Butcher

Seed-producing catkins are pale green and grow erect from the sides of the twigs, while the pollen-bearing, staminate ones, shown at the right, are yellow and hang from the tips of twigs

BLACK CHERRY

Prunus serotina, Ehrhart

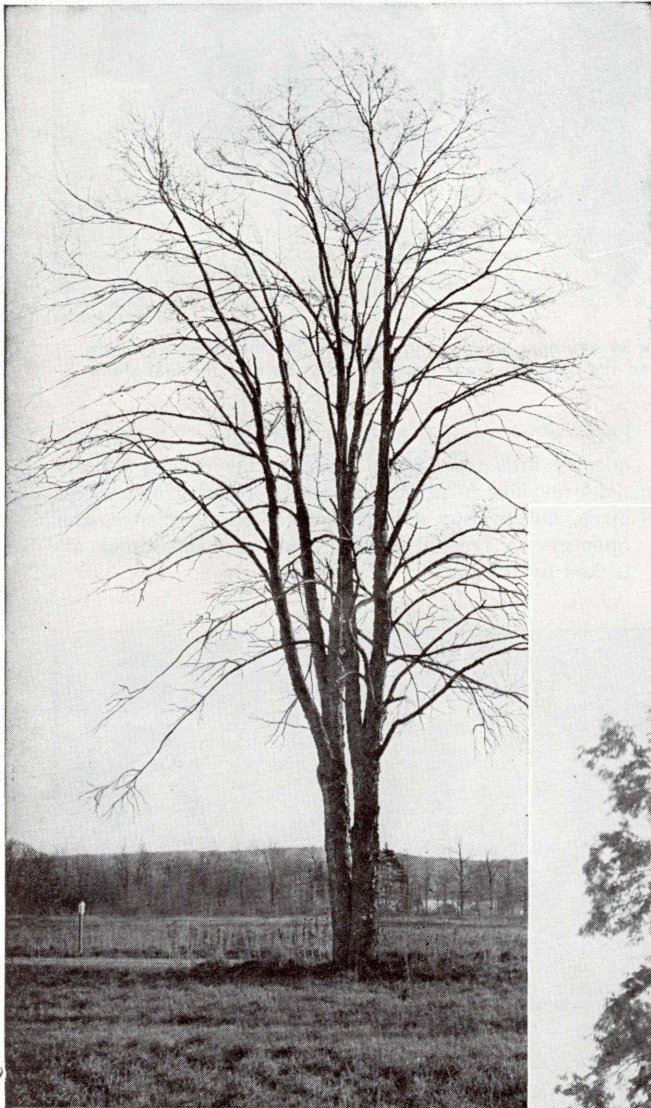
BLACK CHERRY grows in all the eastern states and Nova Scotia as far west as South Dakota, and south through the mountain ranges of western Texas, into southern New Mexico, Arizona, Mexico, Co-

lombia, and Peru. Frequently reaching heights of sixty to eighty feet with trunk diameters at breast height of two or three feet, occasional forest trees are 100 feet high and four feet in diameter, with a clean, uniform trunk extending forty to sixty feet. In the open, tortuous more or less horizontal branches form a spreading oval crown. Best development is found in the Southern Appalachians where ex-

treme ages of 150 to 200 years are attained. It prefers deep, rich soil with uniform moisture, but thrives under many soil and moisture conditions. The dark green, simple leaves are oval or pointedly lance-shaped, with fine incurved teeth on the margin. They occur alternately on the twigs, are two to five inches long, one inch to one and a half inches wide, smooth on both sides, pale green below, with fine hairs near the light colored midrib and veins, and one or more red glands near the base. The slender leaf stem, or petiole, is one-half to three-quarters of an inch long.

In April or May, when the new leaves are still red, four to six-inch drooping clusters of perfect, five-petaled white flowers appear. Domestic cherries produce blossoms before the leaves, so the Latin name *serotina*, meaning "appearing late," refers to the belated flowers, while *Prunus* is the classical name for all cherries and plums.

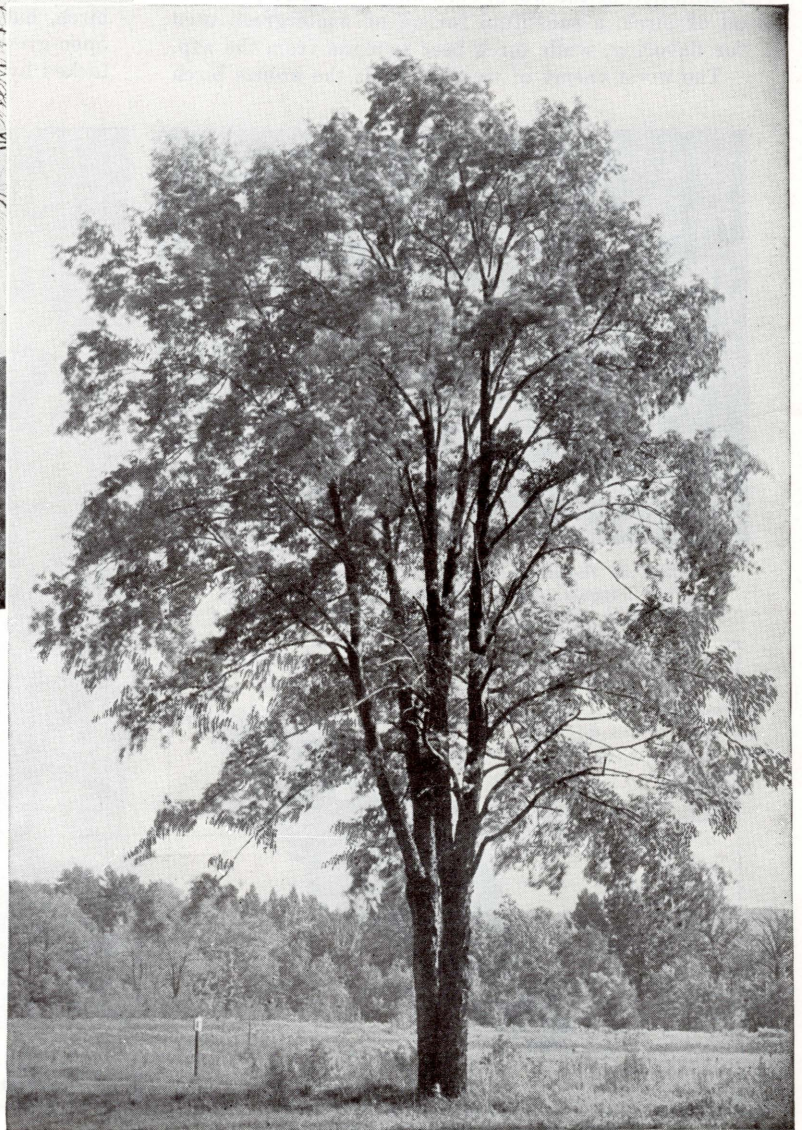
Drooping clusters of pea-sized cherries, so dark red as to be nearly black, with purple, juicy pulp develop by late summer. They have a pleasant, slightly bitter taste and are sometimes used in a beverage called



George J. Baetzhoid

Open-grown Cherry trees develop a spreading oval crown whose tortuous, more or less horizontal branches are clothed in summer with dark green foliage. Forest-grown trees are frequently characterized by a long symmetrical trunk, usually free of side branches

lombia, and Peru. Frequently reaching heights of sixty to eighty feet with trunk diameters at breast height of two or three feet, occasional forest trees are 100 feet high and four feet in diameter, with a clean, uniform trunk extending forty to sixty feet. In the open, tortuous more or less horizontal branches form a spreading oval crown. Best development is found in the Southern Appalachians where ex-



George J. Baetzhoid

"cherry bounce"—hence the name "Rum Cherry." Within each fruit is a thin walled, slightly egg-shaped pit about a third of an inch long, enclosing the seed. Trees bear seed at intervals of three or four years from early youth to old age. The fruit is eagerly eaten by birds who distribute the seeds over wide areas. The seedlings demand sunlight and grow best in the open.

The dark bark of old trees is broken into irregular, easily peeled, scaly plates and is about three-quarters of an inch thick. On young trees and branches it is satin-smooth, dark red-brown, with conspicuous horizontal, pale lenticels or breathing pores. When wounded a gum similar to gum arabic exudes from the bark. The twigs are slender, smooth, red-brown, and like the leaves and inner bark contain prussic acid which gives an aromatic flavor resembling bitter almonds. This element may be responsible for its use in tonics and cough remedies. The same substance may cause severe illness or death to livestock which eat the wilted leaves.

The reddish brown, close-grained wood is hard, relatively light, and when air dry weighs about thirty-six pounds to the cubic foot. The sapwood is yellow and thin. Cherry is extensively used by the printing trade to back electrotypes and zinc etchings. Its beauty, luster, ability to withstand knocks, and ease of working encourage its use for furniture, interior trim, veneers, and tool handles. Like mahogany, the color deepens with age, and the wood ranks close to walnut for cabinet purposes.

The commercial stand is estimated to be 250,000,000 board feet. The reported production of black cherry lumber for 1946 was 35,000,000 board feet. Pennsylvania, West Virginia and New York are the leading states in cherry lumber production.

Cherry trees are susceptible to many insects and diseases. Tent caterpillars feed on the leaves and sometimes fatally denude the trees, while "black knot," a fungus disease of the twigs and branches, causes severe injury. Surface fires permit the entrance of wood-rotting fungi, causing hollow butts.

Cherry is not a satisfactory street tree, but it can be planted anywhere within its natural range for its showy blossoms, its fruit which attracts birds, and its unconventional form.



Drooping racemes of white flowers, with the principal parts in fives, appear after the leaves

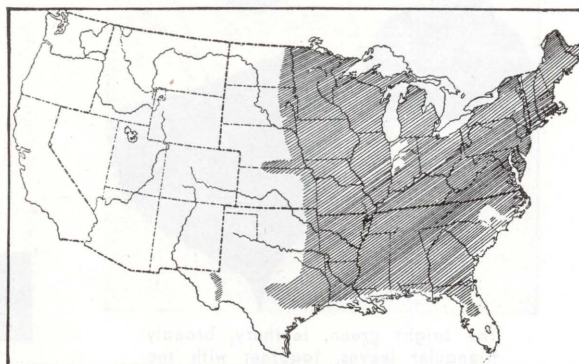


The dark colored bark of mature trees consists of many irregular, easily peeled, scaly plates and may be three-fourths of an inch thick



George J. Baetzhoid

Drooping clusters of dark red cherries with purple, juicy pulp, ripen in late summer and early fall



Natural range of Black Cherry in the United States

EASTERN COTTONWOOD

Populus deltoides, Bartram

THE BROAD spreading crown of eastern cottonwood is common from Quebec to northern Florida and west along the upper streams leading into the Great Plains. Most frequently found along water courses, it often forms extensive groves in the North and West.

Developing first a narrow, conical crown, with maturity it becomes broad and open, supported by a

massive trunk often divided near the ground. Under forest conditions the bole may reach fifty to sixty feet to the main limbs. Ordinarily, eighty to 100 feet tall and three to four feet in diameter, under favorable conditions west of the Mississippi, trees attain heights of 150 feet and diameters of seven to eight feet.

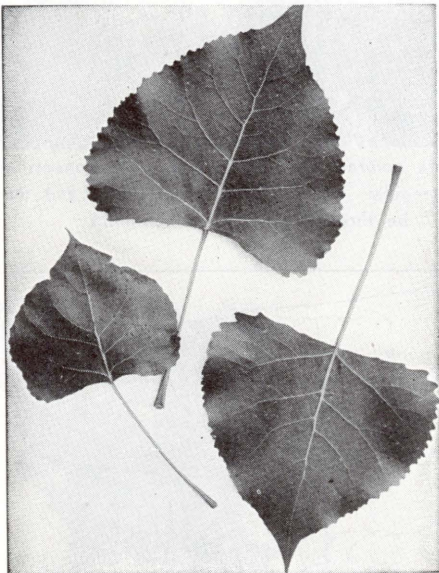
The poplars are of ancient origin and the name *Populus* may refer to an early Roman expression *arbor populi*, the people's tree. Of some twenty-five species recognized throughout the world, eleven are found in North America. Of these *deltoides*, with its delta shaped leaf, is the most important eastern representative.

The bright green, glossy, leathery leaves are broad and triangular, with coarse, rounded, marginal teeth and a flattened stem or petiole about as long as the leaf blade. Together they are four to seven inches long. The shiny brown terminal buds are resin-covered and like the crushed leaves have a pleasant balsamic odor.

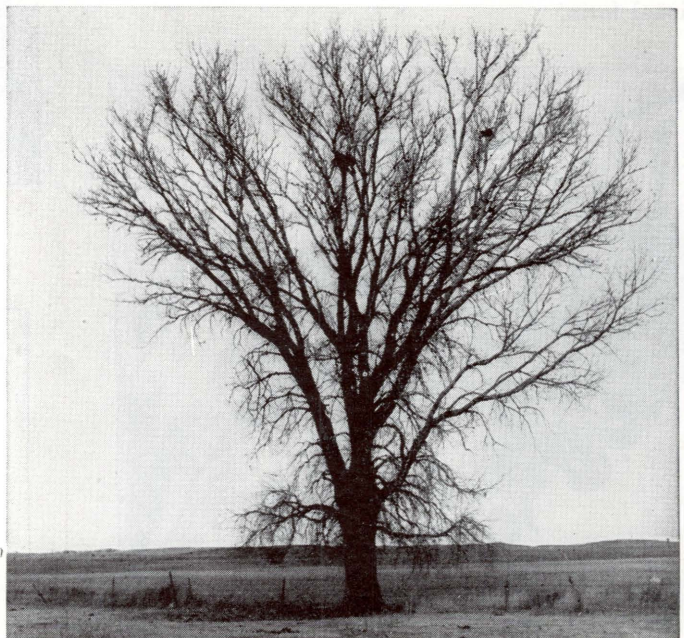
Flowers of each sex are borne separately on different trees and appear in March or April, before the leaves unfold, in three to five inch drooping catkins. By May the more loosely flowered pistillate catkins are six to eleven inches long, with scattered, pointed capsules which expel the tiny, fragile seeds whose attached fibers of fluffy white down carry them long distances. A few hours must bring them to some place of exposed mineral soil such as that on recently flooded banks and river islands or their vitality is lost. Cottonwood also reproduces from stumps and root sprouts and may be readily grown



Cottonwood with its widespreading open crown is familiar to the open plains and prairies



The bright green, leathery, broadly triangular leaves, together with the stems, are four to seven inches long



Winter reveals the short trunk and vigorous growth of limbs and branches

from cuttings. The deeply fissured bark of mature trees is a dull gray to brown, two to three inches thick, with rather wide ridges. On young trunks and branches it is smooth, thin, and grayish yellow tinged with green.

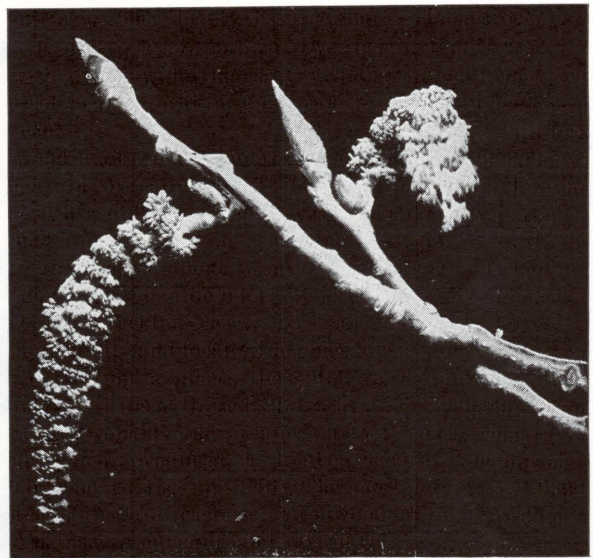
The wood is of varied shades of brown with a thick white margin of sapwood. It is close grained and porous, with a dull luster, soft, weak, usually easy to work, but warps badly in seasoning. A cubic foot when air dry weighs about twenty-four pounds and is almost devoid of taste or odor. It is used largely for boxes, crates, packing cases, excelsior, core for veneers, paper pulp, and locally for poles, posts, and fuel.

A recent estimate places the stand of cottonwood and aspen in eastern United States at 15,662,000,000 board feet. Probably the greater part of this is cottonwood which produced a lumber cut of about 234,000,000 board feet in 1946. The most important producing states for eastern cottonwood are Mississippi, Arkansas, Louisiana and Missouri.

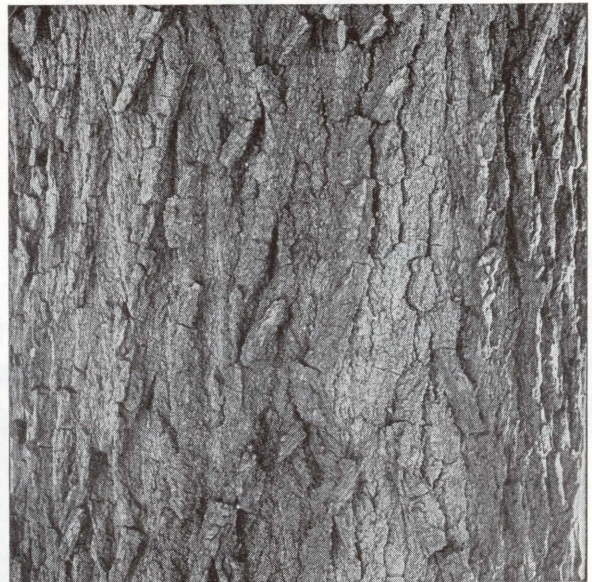
Cottonwood is remarkable for its rapid growth, but height growth declines soon after forty years. Thereafter trees may remain sound and vigorous, but growing slowly, for 100 years or more. Trees have been observed to grow four to five feet in height each year and with diameters increasing two-thirds of an inch for the first twenty-five years. Others reached 100 feet in height in fifteen years.

Frequently planted for shelter and ornament in the treeless plains and prairies west of the Mississippi, the widespread, shallow root system which helps make the tree wind-firm, often upheaves sidewalks. Moreover, the tiny rootlets fill drain pipes in their search for water. Accordingly, many towns and cities prohibit the planting of cottonwood within their boundaries.

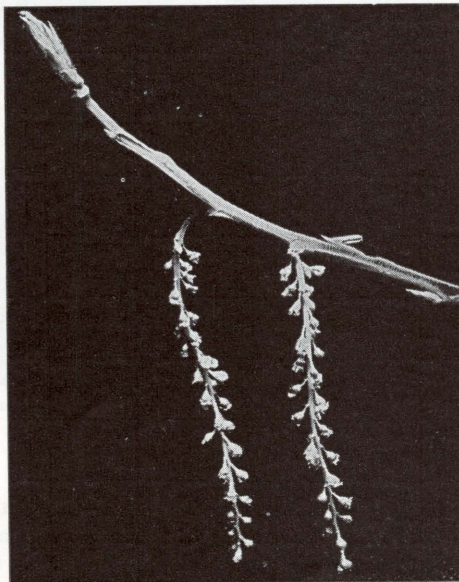
Fire is destructive until after the young trees are fifteen or twenty years old and the bark thick enough to resist the heat. The low overflow lands on which most cottonwoods grow is their chief source of protection. Various fungus diseases are more to be feared, and during the first few years the young shoots are eagerly eaten by field mice, rabbits, and cattle.



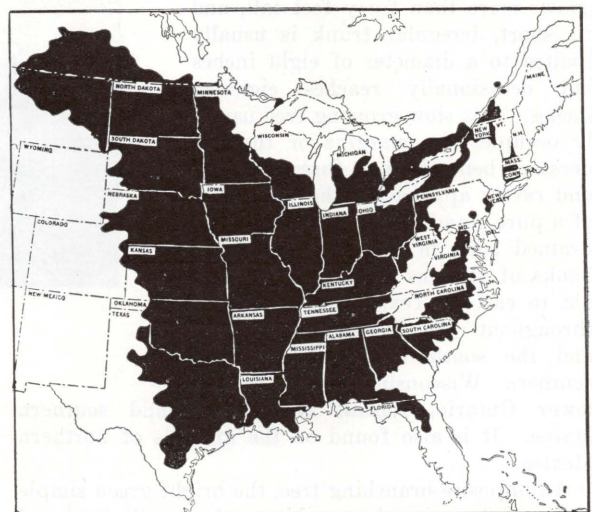
The densely flowered, pollen-bearing staminate catkins are three to five inches long



The mature bark is dark gray to brown with deep fissures and rounded ridges



Long strands of capsule fruits cause the name "necklace" poplar



Natural range of Eastern Cottonwood

FLOWERING DOGWOOD

Cornus florida, Linnaeus

KNOWN best for its showy blossoms, the small, irregular crown of slender spreading branches, the brilliant scarlet autumn foliage, and the highly special-

sharply pointed. They are three to six inches long, two to three inches wide, with prominent midribs and five or six primary veins curving parallel with the contour of the margin. The under surface is light colored and sometimes almost white. In the autumn the upper leaf surface turns bright scarlet.

Large white, pinkish, or rarely rose red blooms appear in late April, May, or early June shortly before or with the unfolding of the first green leaves. The true flowers are inconspicuous, yellow-green, and perfect—forming a dense cluster in the center of what is usually mistaken for the blossom. What appear to be four large petals with deeply notched tips are actually bracts or forms of leaves.

Flowering dogwood gets its name from the profusion of spring flowers, and for the same reason bears the Latin name *florida*. *Cornus* is de-



Devereux Butcher

A tracery of outreaching small twigs and branches characterizes dogwood in winter

ized commercial uses of its wood, combine to make flowering dogwood a tree to be remembered. It seldom grows more than forty feet tall, and its short, irregular trunk is usually limited to a diameter of eight inches but occasionally reaches eighteen inches. This slow-growing tree usually occupies the margins or the understory beneath open forest growth, and rarely approaches the conditions of a pure stand. It prefers rich, well-drained soils in coves or along the banks of streams from central Florida to eastern Texas and northward throughout the Mississippi Valley and the southern Appalachians to southern Wisconsin and Michigan, lower Ontario, central New York, and southern Maine. It is also found on the uplands of northern Mexico.

An opposite branching tree, the bright green simple leaves of flowering dogwood are ovate to elliptical and



Devereux Butcher

The irregularly rounded crown of bright green foliage is seldom taller than forty feet

rived from the Latin word for horn, and refers to the hard, tough wood. *Cornus florida* is the most important of some forty or fifty species of shrubs and small trees of which seventeen are native in North America.

The fruits are often in clusters, each one being

small, egg-shaped and scarlet with a single hard seed. They ripen in October and are only a little less showy than the blossom.

In winter the red terminal buds are like flattened cones and are generally downy near the point. The flower buds are turnip-shaped about a quarter of an inch long and broad. They are always terminal and frequently very numerous. The smooth, slender twigs are yellowish green or bright red, often covered with tiny, closely appressed gray hairs, and are bitter to the taste.

The dark red-brown to almost black bark is closely ridged and broken into four sided or rounded scales after the manner of alligator hide. It is about an eighth to a quarter inch thick and with the root bark has been used as the source of a bitter element for the treatment of fevers. The Indians also derived a form of scarlet from it for dyeing their blankets, feathers and belts.

The relatively small portion of reddish brown to light chocolate colored heartwood is surrounded by a broad area of pinkish sapwood. Its fine, uniform texture with narrow annual growth rings gives a firm, stiff wood which weighs about fifty-one pounds to the cubic foot when air dry. Probably ninety percent of all dogwood is used in the manufacture of shuttles for textile weaving, because the hard, close-textured, smooth wood has little wearing effect upon the thread. It is also used for spool and bobbin heads, small pulleys, skewers, golf club heads, mallet heads, and jewelers' blocks.

Dogwood reproduces from seed, which are borne nearly every year. It will also sprout from the root collar to form coppice growth, and may be successfully budded or grafted. Many birds feed on the seed.



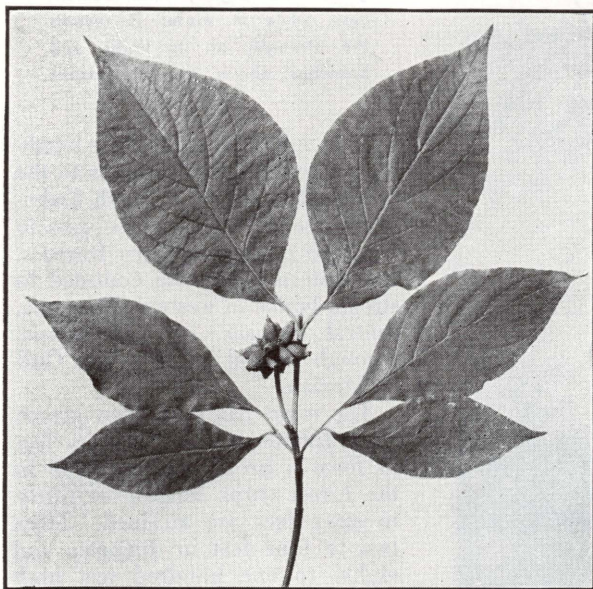
Devereux Butcher

Four large, showy, deeply notched bracts surround the cluster of inconspicuous perfect flowers



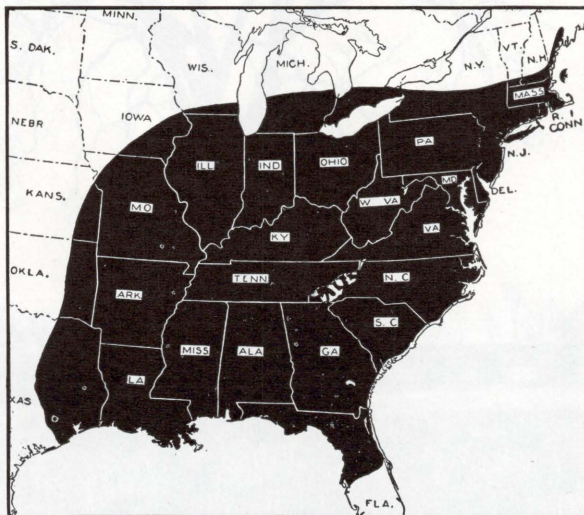
Devereux Butcher

Deeply ridged and broken, the bark resembles alligator hide



Devereux Butcher

The pointed ovate leaves are opposite one another, and the fruit cluster is bright scarlet



Natural range of Flowering Dogwood

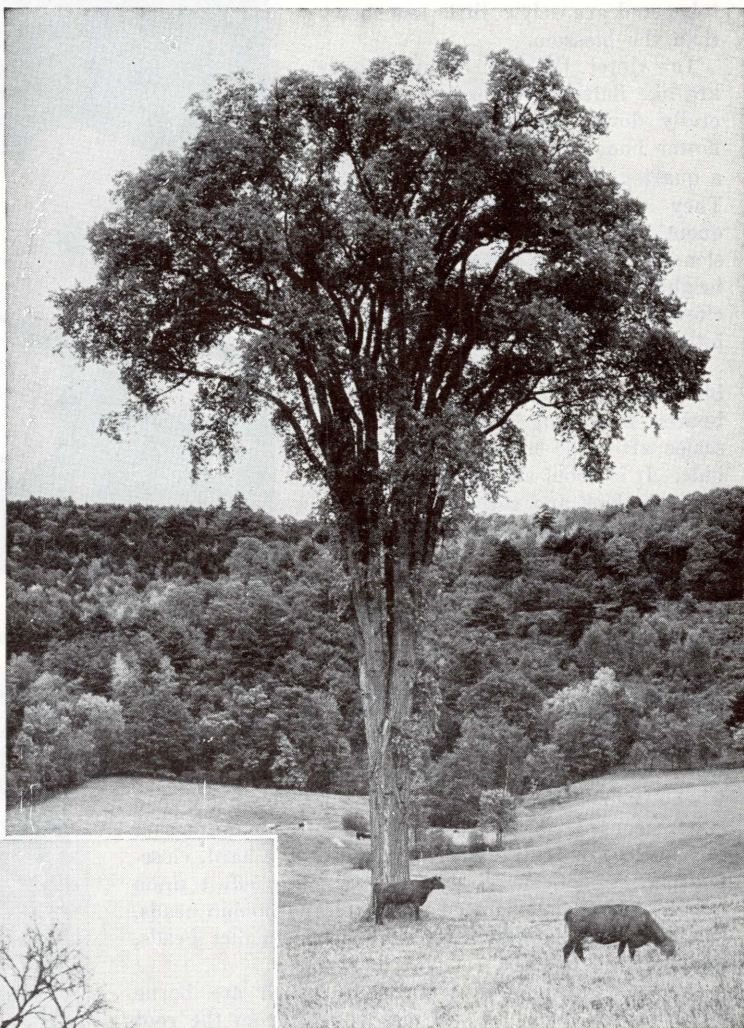
AMERICAN ELM

Ulmus americana, Linnaeus

THE DIGNIFIED and courtly American elm is characteristic of the northeastern landscape and has been planted over most of the United States. Typically vase-shaped, it sometimes develops heavy far-reaching limbs after the manner of the oaks.

Elm belongs to the family *Ulmaceae*, which also includes the hackberries — the family of the nettle. The genus *Ulmus*, which is the ancient Latin name for elm, has sixteen species distributed in the north temperate countries of the world. Six elms are native to eastern North America, with American elm the largest and most important. None is native west of the Rocky Mountains, but they grow successfully in all western states.

American elm is known as white elm, and sometimes as water or soft elm. It grows naturally in river bottoms and on low fertile hills, from southern Newfoundland to central



In summer American Elm combines grace and dignity with courtliness, while in winter it reveals the strength of its limbs and branches above a sturdy trunk



Field Museum

Florida, and west beyond the northern shores of Lake Superior to the Turtle Mountains of North Dakota, thence up the water courses to the base of the northern Rockies. Its western limits are confined to stream banks in western Nebraska, central Kansas and Oklahoma, through central Texas to the Gulf of Mexico.

The main trunk of open grown trees divides at ten or twenty feet to form a broad crown, while in the forest trunk lengths of thirty to sixty feet are attained. Trees two to four feet in diameter and eighty to one hundred feet high are common, but elms eight to eleven feet in diameter and 120 to 140 feet high have been known.

The lopsided, double-toothed, alternately placed, sharp-pointed leaves are two to five inches long and one to three inches wide. Evenly spaced, parallel veins extend from the midrib to the sawtooth edges. The upper surface is slightly rough while the under surface is softly hairy. In early autumn the leaves turn golden yellow, then sere and brown and quickly leave the tree bare.

At the base of each short petiole or leaf stem is a blunt-pointed, smooth, slightly flattened bud, which appears to be at one side of a semi-circular leaf scar after the leaves drop. Before the leaves are fully open, in May or June, the seeds ripen. They are flat, entirely surrounded by a broad, slightly hairy, papery wing, which rarely exceeds three quarters of an inch in diameter. If planted immediately, most of the seed will germinate in a few days, but some may lie dormant until spring. Each seed develops from an inconspicuous light green perfect blossom with red stamens. They hang in clusters and are produced before the leaves, when the tree appears as if covered with a purple glow.

The wood is light brown, heavy, hard, tough, so cross-grained as to be difficult to split, and weighs thirty-three to thirty-five pounds to the cubic foot when air dry. It has a broad area of lighter colored sapwood. Because of its toughness it is used for the hubs of wheels and for hoops and staves in slack cooperage, for shipbuilding, furniture, flooring, sporting goods, boxes and crates. Relatively easy to season, it works fairly well, and while it can be scoured to a clean whiteness, does not polish easily. The Iroquois Indians of western New York used the bark for canoes and twisted it into ropes.

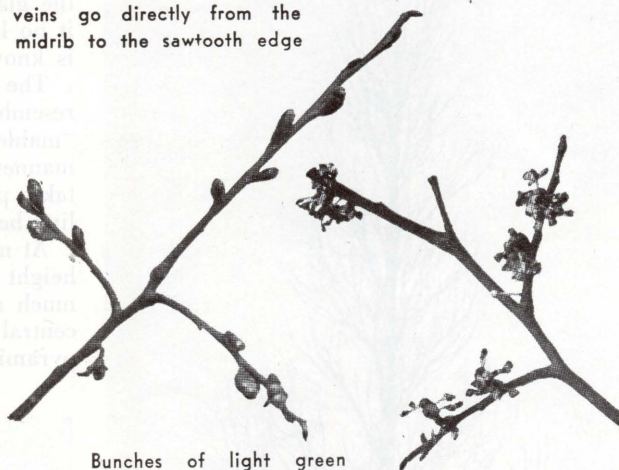
The stand of all species of elm in the United States is estimated at 8,000,000,000 board feet. The cut of elm lumber in 1946 was about 200,000,000 board feet. Wisconsin and Ohio are the leading states.

American elm grows from seed, sprouts readily from the stump and from root ends. Horticultural types may be reproduced by cuttings, buds and grafts. Preferring rich, deep, well-drained loam, it will grow in almost any soil. The vigorous, shallow, fibrous root system permits comparatively easy transplanting until the trees reach a large size.

Of its leaf pests, the elm leaf beetle is chief. By eating the leaves this beetle and its larvae occasionally kill trees, but like other insect pests it can be controlled.



One side of each leaf is larger than the other, and parallel veins go directly from the midrib to the sawtooth edge

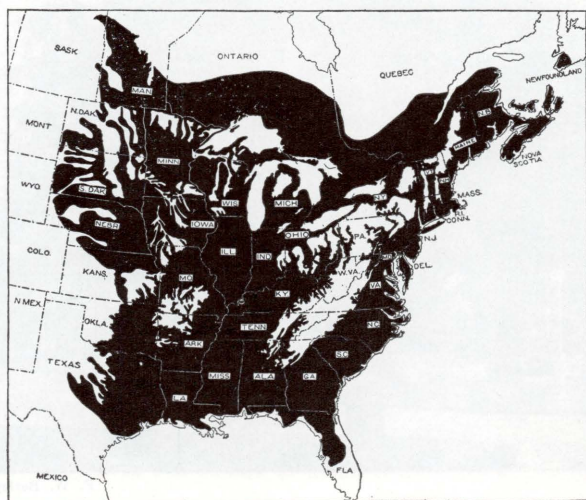


Bunches of light green blossoms appear from last year's buds ahead of the new leaves



Field Museum

The dark, ashy gray bark of the main trunk is broken into interlacing flaky ridges



Natural range of American Elm

Much more to be feared is the Dutch elm disease, for which no cure has been discovered. In spite of enemies, however, American elm is a popular shade tree and its ability to reproduce under forest conditions encourages its use in hardwood forest management.

GINKGO

(*Ginkgo biloba* Linnaeus)

The ginkgo is unique among trees. It is not closely related to any living family or group in the whole vegetable kingdom and is the sole survivor

of a family, rich in species, which was distributed over the temperate regions of both the northern and southern hemispheres when the dinosaurs roamed the earth. It has been called a living fossil for it seems to be identical with fossil species which have been described, and presumably was a common tree in the present temperate and circumpolar regions of the whole northern hemisphere. It seems probable that glaciers caused its extinction in North America, Europe and western Siberia, but in the milder climate of the Orient, which the glaciers did not reach, it survived. Even there, however, it no longer exists in a wild state and in Japan and China it is known only as a planted tree.

The fan-shaped leaf is found in no other flowering plant and resembles the leaflet of the maidenhair fern, hence the name "maidenhair tree" by which it is quite commonly known. The manner of fertilization of the female flower is similar to what takes place in the ferns and botanists have called it a missing link between flowering plants and ferns.

At maturity the ginkgo is a stately tree 100 feet or more in height with a cylindrical, slightly tapering trunk sometimes as much as eight feet in diameter. In youth it has a continuous central column, and is sparsely branched with the spire-like or pyramidal habit of cone-bearing trees. As it becomes older its



Devereux Butcher

At maturity, the Ginkgo is a stately tree 100 feet or more in height with a cylindric, slightly tapering trunk



F. W. Besley

In youth it has a continuous central column and is sparsely branched with the spire-like or pyramidal habit of cone-bearing trees

form is more or less conical. The main shaft usually divides and the crown is made up of several large ascending and spreading branches and many horizontal or somewhat drooping branchlets.

The slender-stalked leaves are more or less incised or divided at the broad summit. They have no midrib but numerous branching parallel veins. Usually measuring from two to three inches across, on vigorous young trees and on shoots which develop from the base of the trunks of old trees they are sometimes from six to eight inches broad. Somewhat leathery in texture, they are bright green when young and dull green at maturity. In autumn they turn a clear yellow. Occurring late in the season, defoliation is unusually rapid.

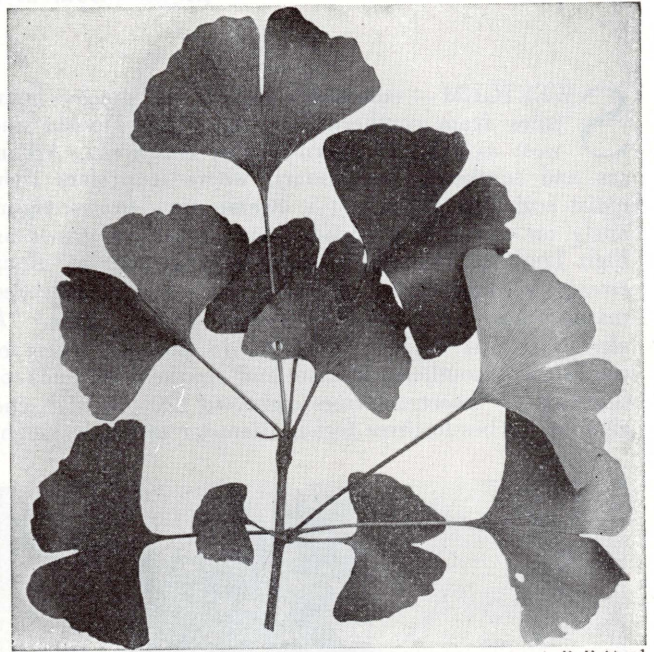
Before the leaves are fully developed in the spring, the ginkgo tree blooms. Its flowers are of two kinds, male and female, and they occur on short shoots of different trees. The pollen-bearing flowers are in arching catkins resembling somewhat those of the oak but stouter and less pendent. The pistillate or fruit-producing flowers, usually in pairs, are borne under small expanded knobs which terminate long stems.

The orange-yellow, plum-like fruit is about an inch in diameter and consists of a thin, outer fleshy layer which covers a pointed oval nut from one-half to three-fourths of an inch long with a smooth, white shell enclosing a soft kernel. On or soon after falling to the ground, the fleshy covering bursts and emits a most offensive odor. When the nuts have been cleaned of the offensive pulp and washed they are pure white, and are known in China as white or silver nuts (ginkgo meaning silver fruit in Chinese). They are sold for food in China and Japan and are eaten at banquets, weddings and social gatherings. The ginkgo is the oldest cultivated nut tree.

The bark is fissured into ridges of irregular shape and on old trees it is deeply furrowed. The winter buds are conical and short-pointed with bright brown scales.

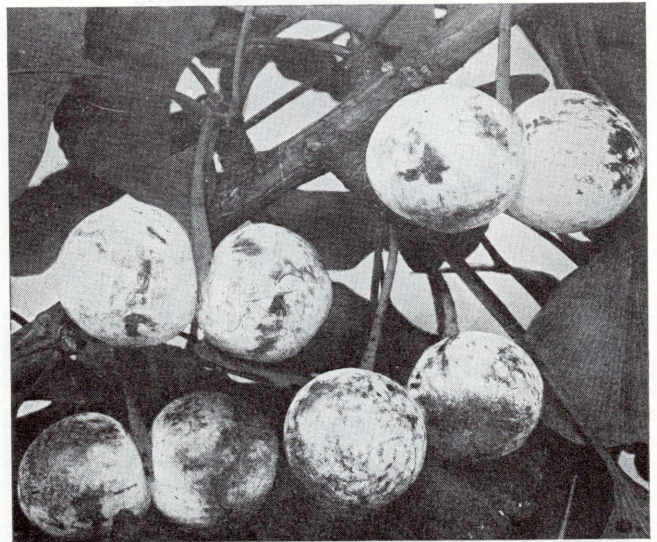
Ginkgo wood is white or yellowish white and there is no distinction between sapwood and heartwood. Light in weight, soft, weak, fine textured and easy to work, the wood is of little value. In China and Japan it is used for chess boards and chess men.

The ginkgo was introduced into Europe in 1730 and into England in 1754, from which country 30 years later it was brought to the United States. It is desirable for planting as an isolated specimen, in groups, or as a street tree, and is not subject to insect or fungus attack. Because of the disagreeable odor of the fallen fruit, the male trees are preferred.



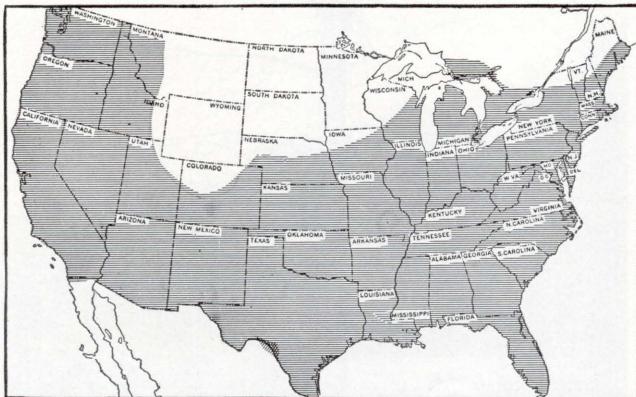
Dr. A. E. Hubbard

The leaves are slender stalked, more or less incised at the broad summit. They have no midrib but numerous branching parallel veins



L. W. Brownell

The plum-like fruit is orange-yellow, about an inch in diameter, and consists of a thin, outer fleshy layer covering an oval nut



Introduced into the United States in the 1780's, the Ginkgo has been planted with fair success in the area shown above



Devereux Boutcher

The bark is fissured into ridges of irregular shape and on old trees it is deeply furrowed. Ginkgo wood is white or yellowish

SWEETGUM

Liquidambar styraciflua, Linnaeus

SWEETGUM — commonly called red gum — flourishes from southern Connecticut to Florida and west as far as eastern Texas, Oklahoma, Arkansas and southeastern Missouri, where it prefers rich, moist soil and, while not a swamp tree, grows vigorously on occasionally flooded land. It also grows on high land, but seldom attains as great size as along stream bottoms where it grows in mixture with red maple, elm, ash, cottonwood and several oaks. A closely related variety reappears in the mountains of central and southern Mexico and in the highlands of Guatemala. Sweetgum trees eighty to 120 feet high and eighteen inches to three feet in diameter at breast height

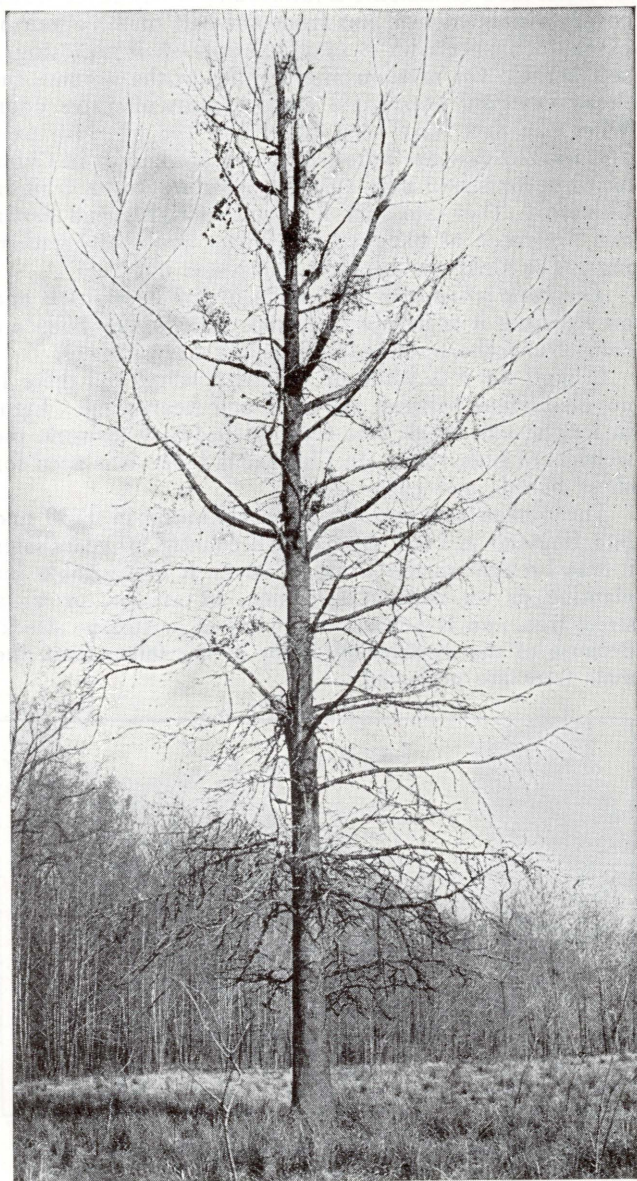
are common. Occasionally, however, they attain heights of 150 feet and are five feet in diameter. They are most abundant and attain greatest size in the bottomlands of the lower Mississippi Valley and the southeastern coastal states. In the forest the trunk is straight and clear of side branches for approximately two-thirds of its height, but young open grown trees have a pyramidal crown with a straight central stem like that of a coniferous tree. With maturity, the side branches become heavier and develop a narrow but more irregular crown.

Sweetgum is frequently confused with the tupelos, but belongs to the witch hazel or *Hammamelidaceae* family. It has three closely related species — one in Mexico, one in central China and a third in parts of Asia Minor where the liquid storax of commerce is secured. The scientific name, *Liquidambar styraciflua*, was given by the Swedish botanist, Carl von Linne, and refers to the yellowish, fragrant, balsamic liquid which exudes from the bark.



Sweetgum becomes a tall symmetrical tree when grown on rich moist bottomland, but will do well on high, well drained soils. The clean trunk, dense glossy green summer foliage, gorgeous autumn coloring and comparative freedom from pests make it a favorite for street and ornamental planting

The slender side branches of the straight central trunk support twigs with corky wings or ridges, from which dry seed balls on long, thread-like stalks, hang through the winter



This resembles the liquid storax of commerce, for which it is frequently substituted. Trees near the northern limit of its range yield little resin, but the flow is abundant in the South.

The glossy, aromatic, star-shaped, five to seven-pointed alternate leaves give rise to the common name, "star leafed" gum. The name "red" gum refers to the color of the wood, but applies also to the brilliant autumn foliage, which compares with that of the maples.

The flowers of both sexes occur separately on the same tree. In the South they appear as early as March, and in the North during April or May, when the leaves are about half grown. The clusters of hairy, green, pollen-producing flowers are two or three inches long, and at the end of the new growth. The seed-producing flowers hang as greenish balls on long, thread-like stalks from the base of the upper leaves. These develop into brown seed balls or burs one to one and one-half inches in diameter and remain swinging on the trees through the winter. Each seed ball consists of a number of closely connected woody, horn-tipped capsules in which are enclosed the seeds. With maturity the capsules split apart permitting the half-inch long, winged seeds to escape.

The slender first year twigs are light orange to reddish brown with prominent lenticels. After the second year corky wings or ridges develop. Larger branches have a broken warty bark which gives the tree the name, "alligator wood." The soft deeply furrowed dark gray bark of the main trunk may be over an inch thick.

Sweetgum develops a long, strong tap root in deep bottomlands, which usually prevents loss from windfall and encourages vigorous growth. The lumber was long discriminated against because of its tendency to warp and twist. Technical studies of the wood structure, and development of kiln-drying during the present century have largely overcome these difficulties. Lumber production of sweetgum now ranks third among American commercial hardwoods. The stand of sweetgum in the United States has been estimated at 26,476,000,000 board feet. The lumber cut in 1946 was approximately 1,000,000,000 board feet and is second only to oak in quantity produced. The leading states in the manufacture of sweetgum lumber are Alabama, Mississippi, Louisiana and Arkansas. They furnish nearly two-thirds of the total.

Sweetgum wood, because of its interlocking grain, is strong and stiff. It works moderately well with tools. Its air-dry weight is thirty-four to thirty-seven pounds to the cubic foot. The hard, straight, close-grained wood is bright brown tinged with red and it has a thin white sapwood. The heartwood has a satiny luster and pleasing, varying figure. Few American woods equal sweetgum in beauty of natural grain but, in deference to the prejudice against "gum" wood, it is frequently marketed as satin walnut, Circassian walnut and hazelwood. Furniture, interior trim, railroad ties, cigar boxes, boxing, crating material, cheap flooring, barrels, woodenware and wood pulps are among its many uses. It is also one of the most important sources of plywood.

Growing largely on lands subject to overflow, fire damage is small. Insects and fungi attack felled trees and those which have been injured by fire and wind, but loss from these sources is not serious.

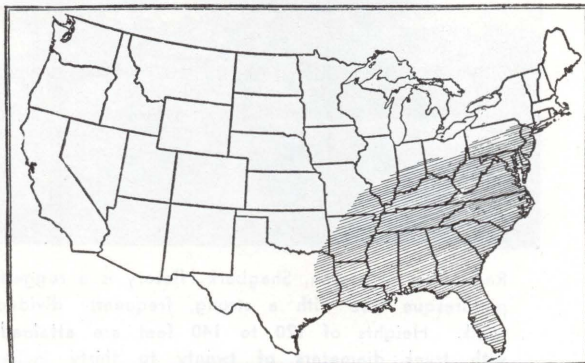
Sweetgum is superb for ornamental planting, ranking with the most beautiful of our eastern broad-leaved trees. It is hardy as far north as Massachusetts, is easily planted and grows fairly rapidly. The splendid fall coloring—gorgeous scarlet, orange and yellow tints as well as purple, lilac and brown tones—together with its freedom from pests make it especially attractive on streets and lawns.



In early spring clusters of green pollen-bearing flowers, glossy green aromatic five-pointed leaves, and dry, horn-tipped seed balls of the previous year are characteristic features of Sweetgum



The soft gray bark is deeply furrowed and usually about an inch thick



Natural range of Sweetgum in the United States

SHAGBARK HICKORY

Carya ovata, (Miller) Britton

SHAGBARK hickory is a distinctly American tree. Only one hickory species exists beyond our continent, and this in eastern China, but during pre-glacial periods they covered Europe and the Mediterranean countries. Of all the hickories, however, none is so important or widespread as shagbark.

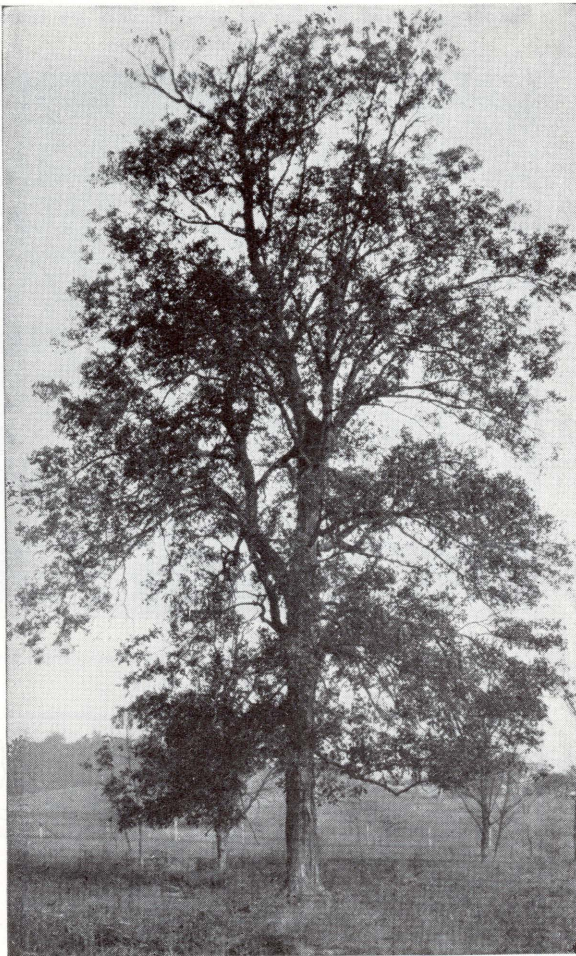
Its irregular, round-topped crown reaches heights of 120 to 140 feet, and the trunk which is frequently divided attains diameters of twenty to thirty inches. It is a common feature of bottomlands and pastures of all the eastern states from southern Maine to southeastern Minnesota, south as far as eastern Texas with the exception of Florida and portions of the Georgia and Carolina coastal plain. Pure stands are rare and best growth is achieved in mixture with oaks and other broad-leaved trees in the Cumberland Mountains and Mississippi River bottoms. Under forest conditions the straight trunk may be clear of branches for fifty to sixty feet.

The compound leaves arranged alternately on the stem have five or seven leaflets whose narrow base is attached directly to the leaf stalk. The three outer leaflets are four to six inches long

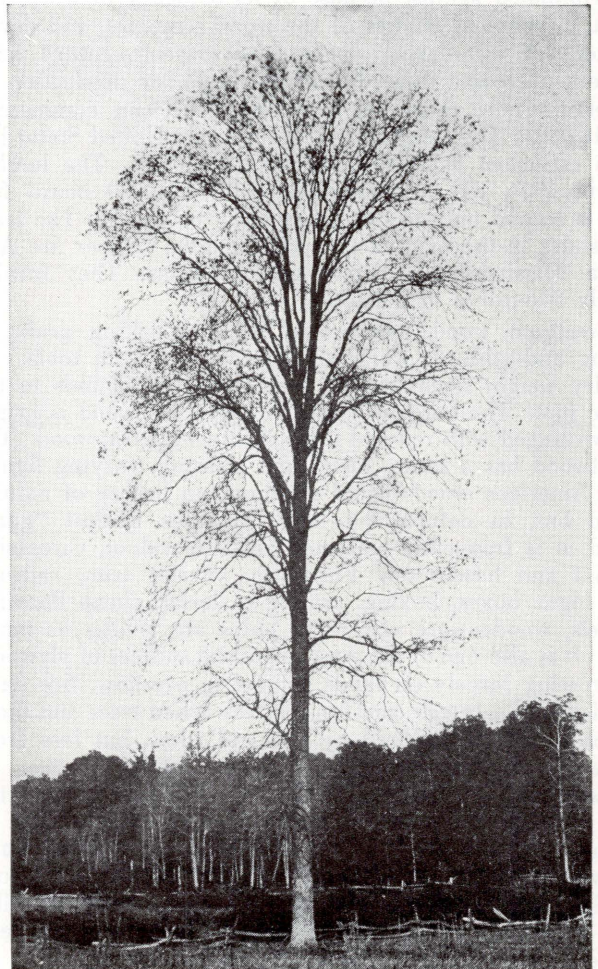
while the lower ones are smaller. Narrow at the base, wide at the top, the margin of each leaflet is toothed and the shape described as obovate.

In May or June while the leaves are developing, separate male and female blossoms appear at the base of new shoots. The drooping spikes of staminate flowers are four to six inches long, while the two to five flowered pistillate ones—one-third of an inch long—are covered with a rusty wooly growth. Those which are fertilized develop during the summer into green semi-spherical fruits one to two and a half inches in diameter. This is described as ovate and is responsible for the name *ovata* to distinguish this *Carya* from other hickories. The thick outer husk splits into four sections when ripe and reveals a single, white, thin-shelled nut whose sweet kernel is edible. These fruits ripen with the frosts of October.

When the leaves drop conspicuous, slightly elevated, roughly heart-shaped leaf scars are left on the twig to persist two or more years. At the base of the leaf stalk and in the curve of the leaf scar a blunt-pointed, broadly ovate bud is completely formed before fall. The terminal bud is one-half to three-fourths of an inch long, blunt-pointed, and covered with slightly downy, dark brown scales. A cross section of the twig reveals an obscure five-pointed star of dark colored pith.



Regardless of season, Shagbark Hickory is a rugged, picturesque tree with a strong, frequently divided trunk. Heights of 120 to 140 feet are attained, with trunk diameters of twenty to thirty inches



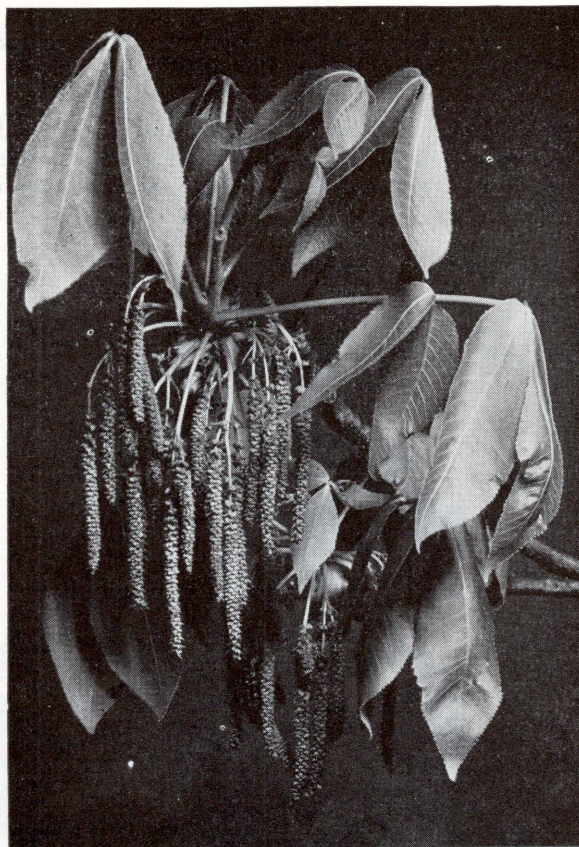
The long, flat plates of gray bark of mature trees, loose at one or both ends, gives the name "shagbark." On young trunks, the bark is smooth, firm and light gray.

The reddish brown heartwood was long considered inferior in strength and toughness to the surrounding two to four inches of white sapwood, but laboratory tests show no material difference. No other commercial wood has the combination of strength, toughness, and elasticity, and no other American hardwood could adequately substitute for hickory in case of shortage of supply. Not durable in contact with the soil, it is subject to attack by boring insects.

Hickory lumber having no more than twenty rings to the inch is generally the strongest, and is used for handles of axes, picks, hammers, and hatchets. Until recently large amounts were used in making spokes and rims of wheels, singletrees, and buggy shafts. Increasing quantities are used in athletic equipment. Hickory wood weighs about sixty-three pounds to the cubic foot when air dry and is admirable for fuel.

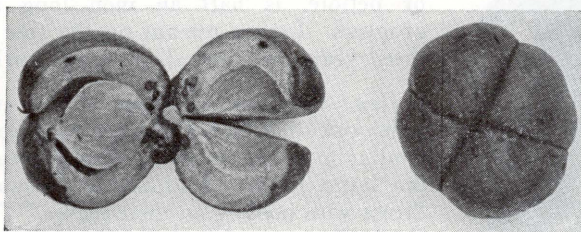
Nearly half the present stand of about 11,000,000,000 board feet of true and pecan hickory grows in the lower Mississippi Valley. The cut of 204,000,000 board feet of hickory lumber in 1946 came largely from West Virginia, Tennessee, Kentucky, and Virginia.

Hickory is reproduced from seeds and sprouts. Two to three bushels of shelled nuts may be produced by thrifty open-grown trees. Trees of seedling origin grow slowly, but may reach ages of 150 to 200 years. The hickories are attacked by various insects, but suffer greatest harm from the hickory bark beetle.



George J. Baetzhoid

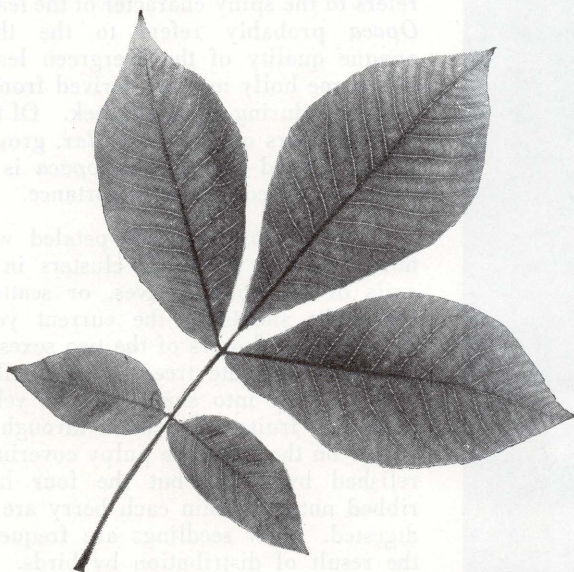
Drooping spikes of staminate flowers



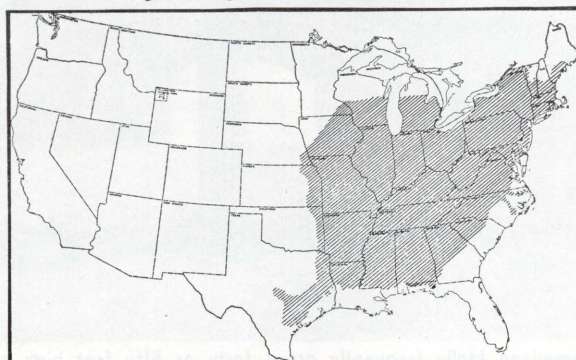
Charles F. Steiger



Long, loose plates of gray bark give Shagbark Hickory its name



Above—Hickory nut enclosed in husk. Below—The compound leaf has five and rarely seven leaflets



Natural range of Shagbark Hickory

AMERICAN HOLLY

Ilex opaca, Aiton

THE glossy, yellow-green spiny leaves and red berries of holly are usually associated with the Christmas season. The tree is less well known than the foliage, but is of economic importance in

several southern states, where it frequently grows forty to fifty feet high, and occasionally eighty feet. The trunk may be one or two feet in diameter, twenty feet long and tapers rapidly. Occasionally specimens four feet in diameter have been reported. The crown is frequently narrowly pyramidal with many short, spreading, nearly horizontal branches. Superficially resembling the English holly, *Ilex aquifolium* Linn, the American holly grows naturally from the coast of Massachusetts, where it is a shrub, southward into Florida, and throughout the Mississippi Valley from the Gulf to Indiana and into West Virginia. In hardwood bottomlands it grows in association with the oaks, and on the flat, sandy coast lands among the pines. Although capable of growing on poor soil, best growth is achieved on deep, fertile, moist soil, and the largest trees are found on the rich bottomlands of eastern Texas and southern Arkansas. The growth is slow but trees may reach an age of one hundred years or more.

The spiny-toothed, alternate evergreen leaves are thick, leathery, and firm, from two to four inches long and one to one and a half inches wide. They are dark, shiny green above and paler, tending toward yellow on the lower surface. The midrib and lateral veins are prominent on the lower surface, and the stout stem, or petiole, is half an inch long and grooved. Leaves remain on the tree for three years and are shed in the spring.

Ilex, the classical name of the evergreen oak of southern Europe, with leaves similar to holly, is one of five genera of the large family *Aquifoliaceae*, meaning "trees with needles on their leaves." Thus the Latin name of both family and genus refers to the spiny character of the leaves. *Opaca* probably refers to the thick, opaque quality of the evergreen leaves. The name holly may be derived from its early use during the holy week. Of thirteen members of the genus *Ilex*, growing in the United States, *Ilex opaca* is the only one of economic importance.

The inconspicuous four-petaled white flowers appear in small clusters in the axils of the young leaves, or scattered along the shoots of the current year's growth. The flowers of the two sexes are borne on separate trees. The pistillate ones develop into small, red or yellow berry-like fruits and remain through the winter on the tree. The pulpy covering is relished by birds, but the four hard, ribbed nutlets within each berry are not digested. New seedlings are frequently the result of distribution by birds. Although attractive to birds, the berries should not be eaten by human beings.



American Holly frequently grows forty or fifty feet high and develops a dense, pyramidal crown with many short, nearly horizontal branches

Leaves and bark of holly, and other *Ilex* plants contain ilicin, a bitter material possessing tonic properties. Holly leaves have been used to treat fevers and rheumatism. Paraguay tea, known as *Yerbe de Maté*, is derived from one plant of this genus, and cassina tea from another.

The smooth, light gray bark is approximately a half inch thick and becomes roughened by wart-like excrescences in old trees. In color and texture, it resembles the bark of beech.

The wood is hard, tough, close-grained, not strong, but moderately heavy, weighing thirty-six to forty pounds to the cubic foot when air dry. The heartwood is creamy or ivory white when first cut, turning brownish with age or exposure, and takes a high polish. The sapwood is wide and whiter than the heartwood. It is used for cabinet work, turnery, small musical instruments, and, because of its similarity to ivory, as keys for pianos and organs. Its fine grain makes it useful for wood engraving. Present supplies of merchantable sizes are limited and scattered.

Holly is tolerant of shade, will recover from suppression after growing years under heavy shade, and young trees are capable of producing sprouts.

A deep tap root supported by numerous spreading laterals makes possible the transplanting of young trees. The best time to move them is in the fall, when the new wood is nearly ripened, or in the spring before new growth starts. When transplanting wild hollies from the woods, the tops should be severely pruned and most of the remaining leaves removed.

Holly berries may be sown in beds and covered with a heavy mulch until the spring of the second year, when the seed will germinate. Thereafter, the mulch should be removed and the seedlings given partial shade. Cuttings of the current year's ripened wood, with a little of the two-year-old wood and three or four leaves, made between August and December, may be rooted under a glass frame, or in a greenhouse. These should be set slanting in about six inches of mixed peat moss and soil, with the leaves lying flat on the surface.



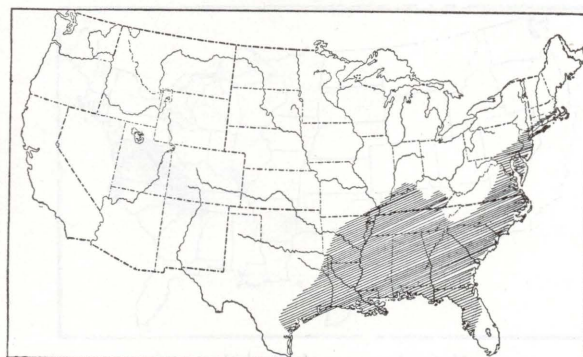
The spiny-toothed, leathery, alternate evergreen leaves remain three years on the branches and are shed in the spring. These, with red berries, are widely used for Christmas decorations



The bark is light gray, approximately a half inch thick and becomes roughened on old trees



Inconspicuous white flowers with four petals and stamens are borne from April to June in the axils of young leaves and on shoots of the current year's growth



Natural range of Holly in the United States

BLACK LOCUST

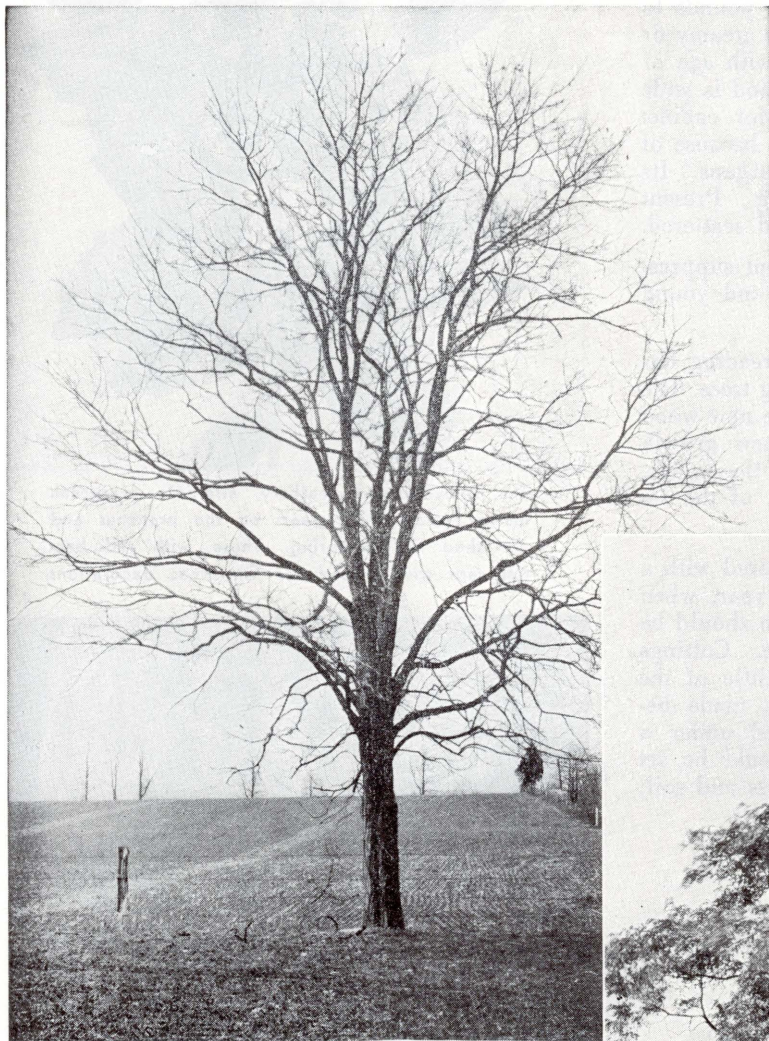
Robinia pseudoacacia, Linnaeus

THE BLACK LOCUST, or false acacia, *Robinia pseudoacacia*, sometimes called yellow locust, belongs to the pea or legume family, and has the quality of adding nitrogen to the soil. It was originally native to the Appalachian Mountains from Pennsylvania to Georgia, and to parts of Arkansas and eastern Oklahoma, but has

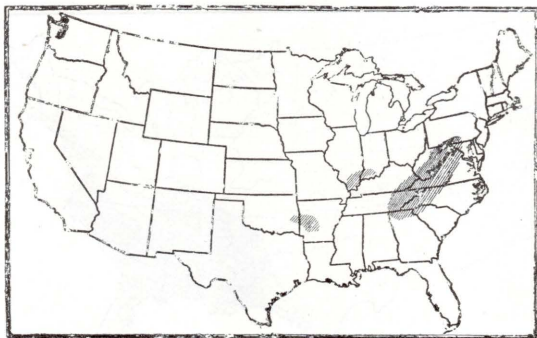
been successfully planted in every state. In its natural range black locust grows along streams, in mountain coves or on the borders of forests, and usually in mixture with other hardwood trees. In many parts of the country it has escaped from cultivation and so established itself as to be generally accepted as native. It prefers deep, sweet, well-drained fertile loam and soils with a limestone origin having brown or reddish brown subsoils, but will grow almost anywhere except in soils which are poorly drained or either very wet, heavy or acid.

Trees may attain heights of forty to eighty feet and trunk diameters of two or four feet, but they seldom live over 100 years.

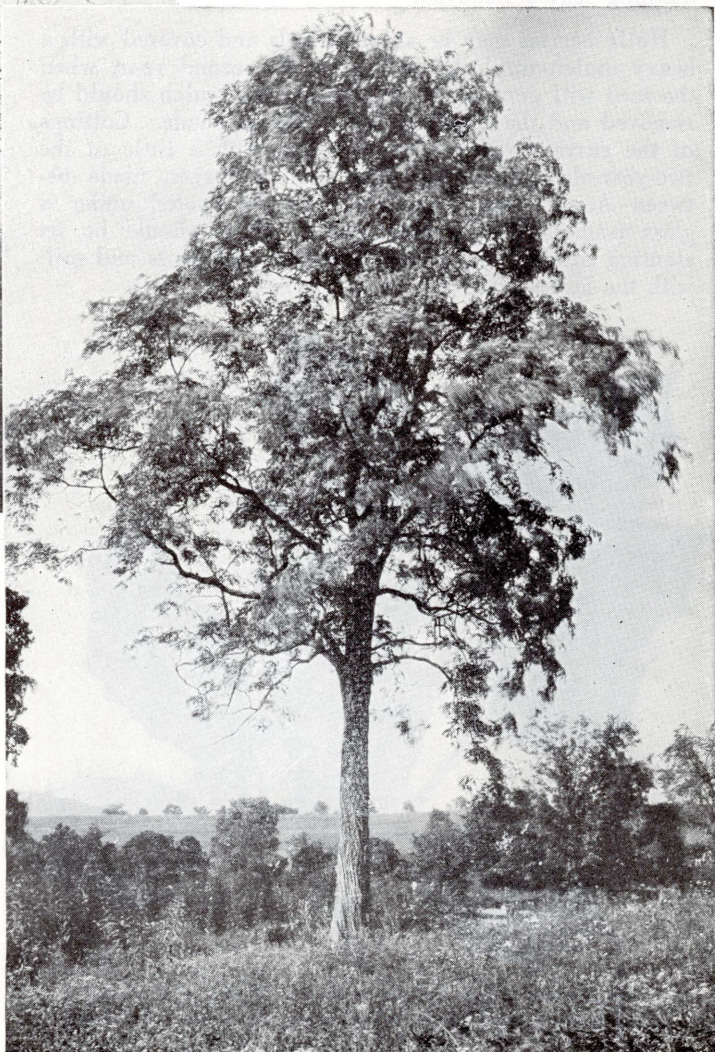
The open branching and frond-like leaves give the crown the appearance of a plume. The alternate and pinnately compound yellow green leaves are eight to fourteen inches long and composed of seven to nineteen rounded leaflets, each on a slender stalk. They develop in April or early May. During rainy days and on the approach of evening



Black Locust forks frequently and develops a rather uneven crown which gives a plume-like appearance to the tree when in full leaf, while the seeds in their bean-like pods, flutter and rattle all winter



Natural range of Black Locust



the leaflets fold and the entire leaf droops slightly, after the manner of the true acacias. By the end of September or occasionally early October the leaves turn a pale, clear yellow before dropping.

The dark, reddish brown, rough, deeply fissured bark is an inch to an inch and a half thick and frequently twists diagonally across the trunk. Tonic, purgative and emetic qualities are reputed for the inner bark and roots of the trunk.

The twigs are pale green and silvery in the spring, turning reddish brown in the summer and marked with scattered pale lenticels. They bear pairs of short woody spines or thorns like those of a rose.

The new leaves are scarcely formed when clusters of fragrant white pea-like blossoms appear over the entire tree. These are perfect flowers, having a pistil as well as stamens, and are filled with nectar which attracts bees and other insects. From these come thin, smooth, bean-like pods with four to eight little dark orange seeds which ripen during Septem-



The pinnately compound leaves are alternate on the twig, but each of the seven to nineteen oval leaflets, borne opposite each other forms the full leaf

ber and October but hang on the trees through the winter.

Black locust wood weighs about forty-eight pounds to the cubic foot when air dry, and is stronger and stiffer than white oak. Freshly cut wood is greenish yellow to dark brown, coarse grained and surrounded by creamy white sapwood.

Black locust is supreme for use as insulator pins which are inserted on the cross arms of telephone and power transmission lines. Approximately 18,000 cords of high quality timber are necessary to make the 25,000,000 pins which have been manufactured in a single year for this use. Smaller amounts go into the hubs of wagon wheels, for treenails to pin ship timbers together and for fence posts, mine timbers, poles and tool handles.

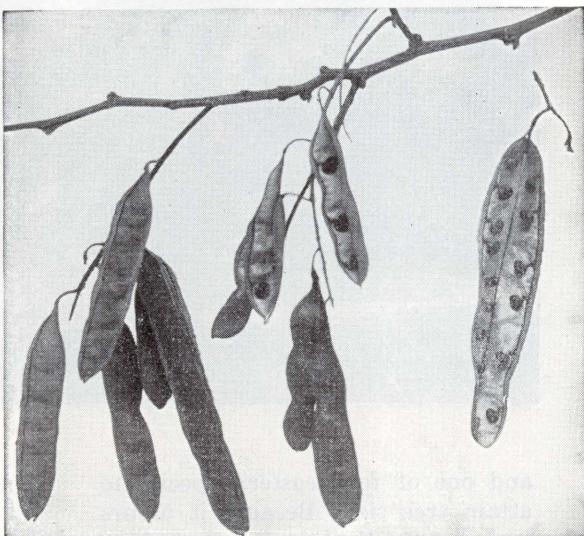
The commercial stand of black locust is estimated at 400,000,000 board feet, and the annual cut for all purposes is placed at approximately 8,000,000 board feet. Few stands have as much as twenty cords to the acre, and large areas seldom average more than a cord to the acre.

It was introduced in Europe during the early part of the seventeenth century by Jean and Vespasien Robin, herbalists to the King of France and, bearing their name, is now the most generally accepted American tree in Europe. Because of its widespread fibrous root system, its tendency to send up new shoots from the roots, and the ability which it has with most other leguminous plants to develop nitrogen-fixing nodules on its roots, black locust is unusually adapted to the reclamation of soils and control of erosion.

Serious injury and disfigurement frequently follow attacks by the locust borer, and in some parts of the East a leaf miner gives the foliage a ragged, burned appearance.



Racemes of fragrant white pea-like flowers appear in May and June. (Below) Dry bean-like seed pods with four to eight seeds



The deeply furrowed orange-brown bark of the trunk is an inch or more thick

RED MAPLE

Acer rubrum, Linnaeus

EXTENDING over much of the eastern half of the United States and into Canada is the red maple, one of thirteen or more of the family *Aceraceae*, native to North America,



greater than 150 years. Long before reaching this age, under forest conditions a broad, round crown is developed with a moderately long clear trunk, the whole tree averaging sixty to ninety feet in height and one and a half to two and a half feet in diameter at breast height. Occasionally trees grow to a height of 125 feet and are five feet in diameter.

Red maple is best known by its three to five-lobed, doubly toothed, simple, bright green leaves which are three to four inches long, nearly as broad, and occur opposite one another on the twigs. While smooth above, the leaves are finely hairy beneath and have slender stems or petioles two to four inches long. Although basically green, the stem may be tinged with red, and in the early autumn the leaves turn to brilliant shades of scarlet, frequently mixed with orange, giving one of many reasons for the

Open-grown Red Maple develops a short trunk and a broad oval crown

George J. Baetzhoid

and one of four eastern species to attain tree size. Because it occurs on low ground or in swamps, along the banks of streams where it will stand long periods of inundation, and on moist soils, it is frequently known as swamp maple. It thrives in any moist fertile soil.

Usually associated with other lowland trees such as black ash, the gums and cottonwoods, cypress and water oak, the largest sizes and best development are in the lower Ohio Valley, while greatest abundance is in the lower Mississippi Valley. Growth is rapid during the early stages, but trees seldom attain ages



Latin name *Acer rubrum* which translated is red maple.

The small but conspicuous clusters of ruby red flowers open in March or April considerably before the leaves. They occur as distinct male and fe-



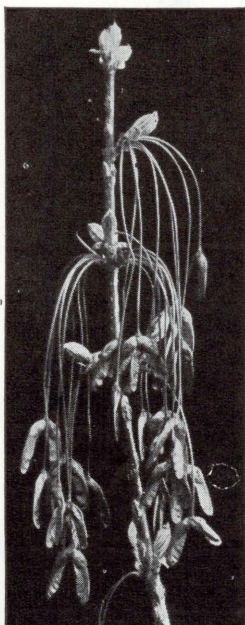
Ruby colored staminate blossoms and the three to five-lobed leaves which appear later



George J. Baetzhoid

male blossoms and may be on the same tree or segregated on different trees. By spring or early summer the fertile pistillate blossoms have developed into the characteristic key.

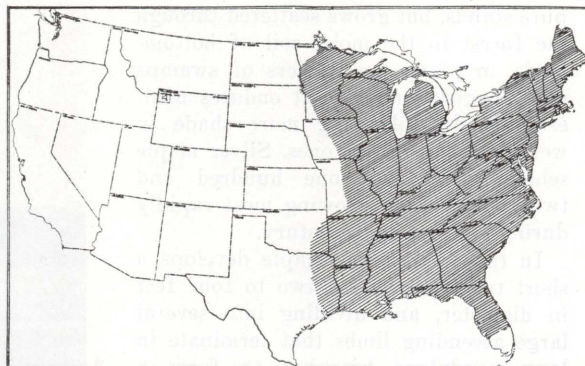
Red maple wood resembles that of hard maple, but the heartwood is light brown tinged with red while the sapwood is lighter colored. It is hard, close-grained, easily worked and weighs when air dry about thirty-eight pounds to the cubic foot. It is used for furniture and cabinet work, flooring, interior finish, veneers, gunstocks, and woodenware, while considerable quantities are burned in kilns to produce wood acetate and charcoal. The commercial production is not distinguished from the other maples, of which red maple holds second place to the sugar maple.



Clusters of newly formed maple keys



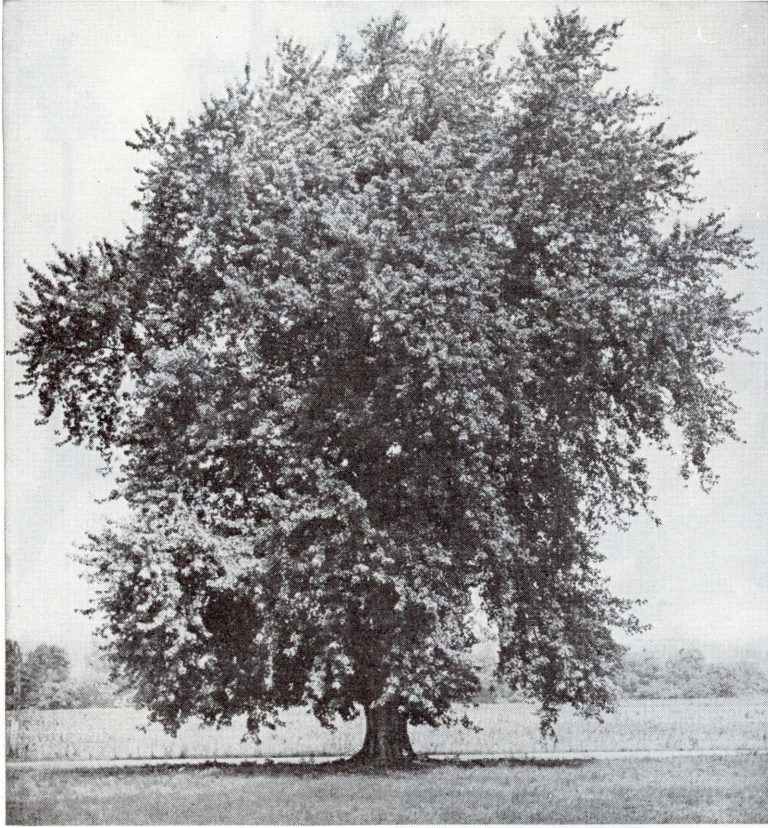
Red Maple bark is dark gray and flaked



Natural range of Red Maple in the United States

SILVER MAPLE

Acer saccharinum, Linnaeus



Open grown Silver Maples develop a short trunk that divides into several large ascending limbs with long pendulous branches

Devereux Butcher

trees have trunks that rise clear of limbs for thirty to fifty feet before the branches form a medium broad crown sixty to eighty feet high. In the Ohio basin silver maple is more abundant than elsewhere in its range, where it sometimes grows to a height of one hundred and twenty feet.

During the first mild days of late winter or early spring when the leaf buds have scarcely begun to swell, the yellowish green flowers appear. Growing in short-stalked, thick clus-

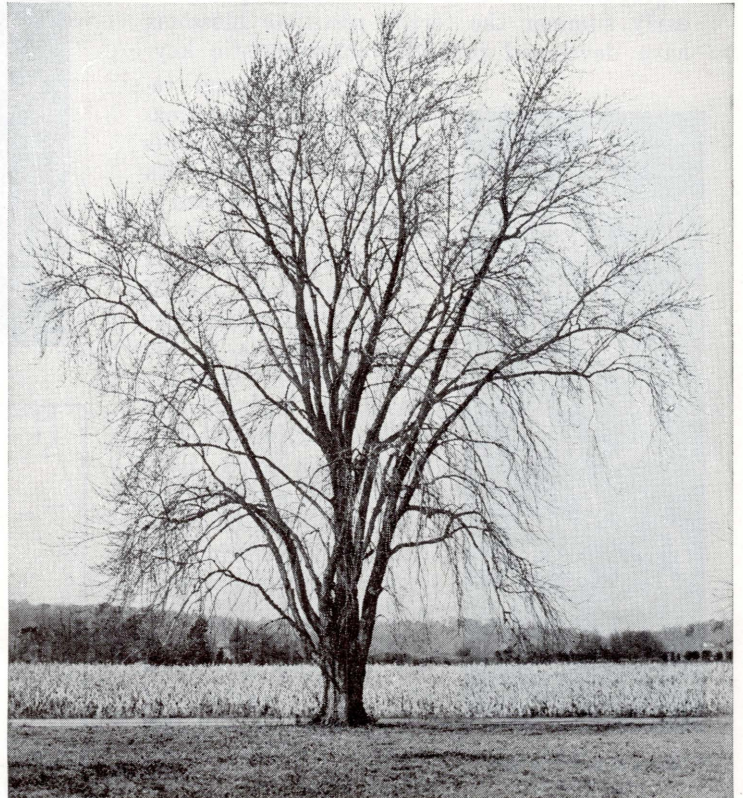


Bark on trunk and larger limbs of mature trees is thin, gray, and broken into broad, flaky scales

SILVER maple, sometimes called soft maple, is one of sixty or seventy species of the *Acer* family distributed widely over the Northern Hemisphere, with one species south of the equator in the mountains of Java.

It is found as far north as New Brunswick and westward across southern Quebec, Ontario, Michigan, to southeastern South Dakota and Kansas. Although seldom found on the Atlantic Coast or on the high Appalachian Mountains, its range extends south to western Florida and Oklahoma. It never forms pure stands, but grows scattered through the forest in the moist soil of bottomlands, or along the borders of swamps and sluggish streams. It endures moderate shade, tolerating more shade in wet sites than in dry ones. Silver maple seldom lives over one hundred and twenty-five years, growing most rapidly during its first half century.

In the open, silver maple develops a short trunk measuring two to four feet in diameter, and dividing into several large ascending limbs that terminate in long pendulous branches to form a broad, rounded crown. Forest grown



Devereux Butcher

ters on the twigs of the preceding year, the staminate and pistillate flowers appear on the same or different trees. Later leaves appear borne on slender drooping stems. They are pale green and shiny above, smooth and silvery beneath, and measure four to six inches long and nearly as broad. They are five-lobed, deeply indented, sharply toothed with an even or heart-shaped base. The seeds occur in pairs or keys, suspended in clusters on slender, drooping stalks and have thin divergent wings one to two inches long. Some seed is produced every year, but abundant crops occur at irregular intervals. When they fall on moist soil, germination follows shortly and before the end of the summer have produced plants with several pairs of leaves. Silver maple sprouts readily from the stump, but trees begin to lose the ability to sprout or coppice after the trunk diameter exceeds a foot.

The thin gray bark on trunk and larger limbs of old trees is broken into broad scales which flake off readily, while on younger trees and on branches of mature ones it is smooth, gray, or slightly tinged with brown. Twigs are green or reddish, and when broken, give out a rank odor. Leaf buds at the ends of the twigs are encased with three or four pairs of red scales and measure about one-quarter inch in length. Buds along the sides of the twigs are borne on short stalks and are usually accompanied by the lustrous flower buds.

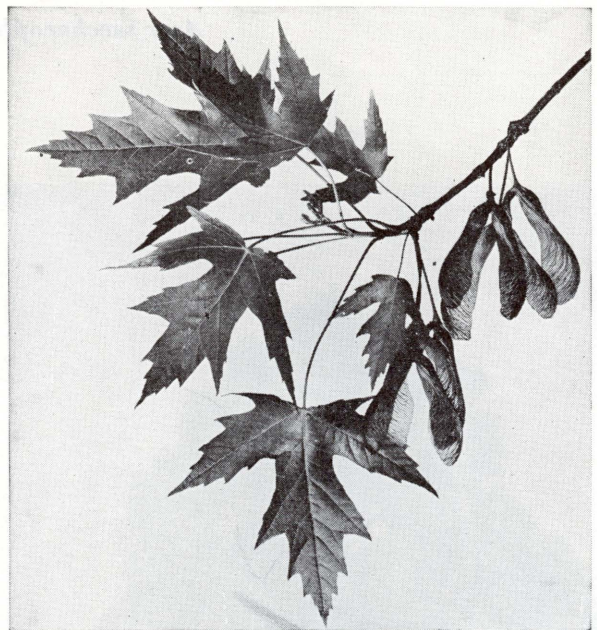
The light brown wood weighs thirty-four pounds to the cubic foot when air dry, is strong, brittle, close-grained and rather hard. The sapwood is pale to almost white and with the heartwood takes a good polish and is used for cheap furniture, flooring, interior finish, woodenware, veneer and fuel. Considerable quantities are burned for charcoal, wood acetate and other products of distillation. Silver maple is sometimes mixed with the wood of other maples but is not as strong, hard or heavy. It is estimated that silver maple forms about five percent of the total maple cut in the United States.

It is widely planted as an ornamental tree along roadsides and around homes, where its principal attribute is the comparative rapidity with which it grows. The tree, however, is not as well adapted for this purpose as are the sugar and red maples, because its limbs are brittle and are quite subject to injury by wind and ice storms. Large silver maples in cultivation are sometimes pruned as a means of helping them resist such damage.

The cottony maple scale, a sucking insect, is an enemy of the tree; while the wood is attacked by the boring leopard moth. Mature trees often have hollow trunks or show heart rot due to attack by fungus diseases. When growing in the forest, this tendency to become hollow makes the tree valuable to many forms of wildlife such as raccoon, opossum, and owls. Owing to the thinness of its bark, fire is another serious enemy of the species, although the usually moist sites in which the tree grows somewhat reduces the fire danger.

There are several varieties of silver maple known as cutleaf maples. These have twigs and branches that are more drooping than those of silver maple, and leaves that are more deeply cut and decorative. These varieties are used ornamentally in parks and on estates.

Silver maple has a shallow, spreading root system with a small taproot.

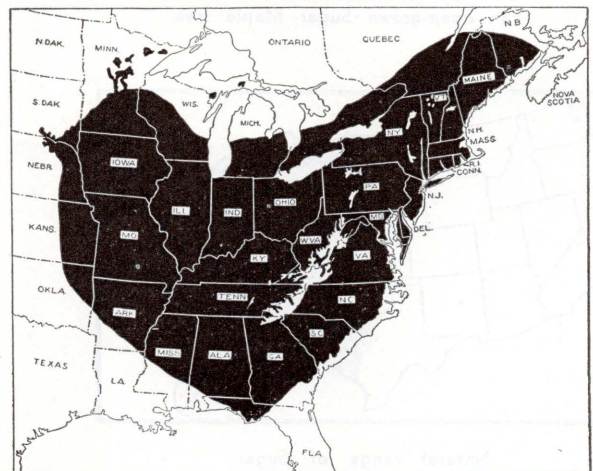


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Leaves are green above, and silvery beneath, while the seeds which ripen in spring occur in pairs or keys



Staminate flowers occur on the same or different trees from the pistillate, and are yellowish green



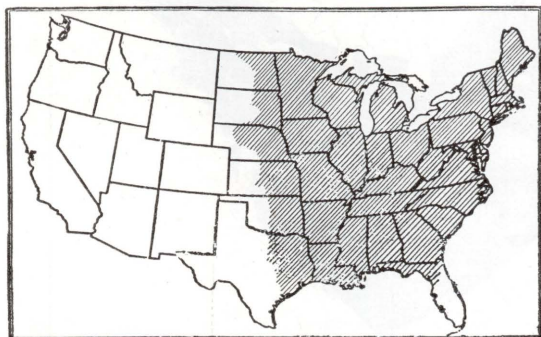
Natural range of Silver Maple

SUGAR MAPLE

Acer saccharophorum, K. Koch

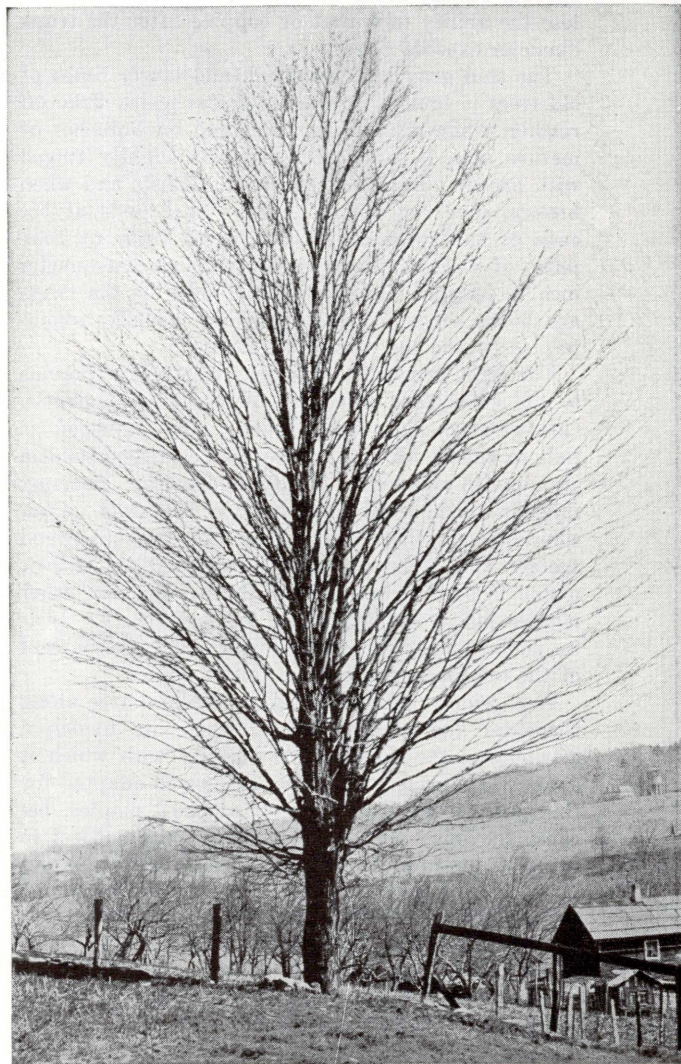


The symmetrically rounded head of an open-grown Sugar Maple tree



Natural range of Sugar Maple in the United States

SUGAR maple grows naturally in every state east of the Great Plains but most vigorously in the northeast and in the higher elevations of the southern Appalachian Mountains. The name, sugar maple, refers to the spring crop of sugar and syrup that is boiled from its sweet sap. In autumn the leaves change from green to brilliant reds and yellows, and are an outstanding feature of the northern land-



In winter the relatively short stem and skeleton of many branches is revealed

scape. Open grown maple trees have a short trunk and a compact, globular crown. In the forest the tree lifts a relatively small rounded crown high upon a long trunk, to attain total heights from seventy to 130 feet. Forest grown maples are frequently two or three feet in diameter and have been known to attain five feet.

The smooth silvery bark of young trees becomes darker, more broken and deeply grooved as the tree matures. Frequently conspicuous shreddy flakes are developed.

Distinguishing features of most maples include the five-lobed leaf, the delicate pointed buds which grow opposite one another, the double winged fruit or key, and the opposite branching. Large quantities of fertile seeds mature in the early summer from inconspicuous, long-stemmed flowers that appear with the new leaves in April or May. Staminate and pistillate flowers are in separate clusters on the same tree, but occasionally a tree may have flowers of only one sex. *Acer*, the scientific name of the maple family, means hard or sharp. The Romans used European maple for pikes and lances as well as for tables and other furniture. *Saccharophorum* refers to the sweet sap. Most widely known as sugar maple or hard maple, it is also known as sugar tree and rock maple, while a botanical variation is known as black maple. Nearly a hundred species of maple are distributed over the northern hemisphere, of which thirteen are native within the United States. Maple trees and shrubs extend across the equator to the mountains of Java, and reach toward South America in the uplands of Central America. Most of the Old World species grow in the valleys of southeastern Asia.

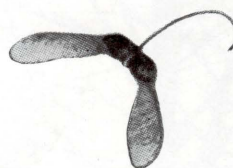
The wood is known to the lumber trade as hard maple, and the bulk of maple lumber is of this species. The wide white sapwood may stain to a pale brown if improperly seasoned. The heartwood is light reddish brown, and the luster of each helps distinguish sugar maple from other maple wood. A cubic foot of air-dry maple weighs forty-four pounds. Although lighter than white oak, the wood is stronger and stiffer, and ranks as one of our more valuable hardwoods. The total stand of maple in the United States is estimated at 44,000,000,000 board feet, three-fourths of which is believed to be sugar maple. The lumber cut of sugar and black maple in 1946 was 587,000,000 board feet. Maple is used for flooring, shoe trees, agricultural implements, musical instruments, furniture and a wide variety of materials which need a strong, firm, close-grained wood able to stay in place and capable of taking a polish. Accidental forms with contorted grain, known as curly maple and bird's eye maple, are prized for cabinet-making.

Maple syrup and sugar are important spring crops on many farms in Vermont, New York, Ohio, Pennsylvania, and Michigan. Ordinarily forty-five to fifty gallons are boiled down to make a gallon of syrup, and fifteen to twenty gallons of sap are secured from most of the trees. In 1940, 2,680,000 gallons of syrup and 550,000 pounds of sugar were produced from 10,288,000 trees.

Capable of growing under a variety of conditions, it grows especially well on gravelly, slightly alkaline soils. A few plantations have been established for sugar as well as lumber production, but the slow growth does not encourage such an investment. It grows readily from seed and is an important element in the management of many northern forests.

Although not so well adapted to city street conditions as some of the other maples, it is a favorite on suburban streets and country roads. Seedlings and small trees are easily transplanted. It is recommended for street and landscape use in the northern part of its natural range, in western Washington and Oregon and the northwestern counties of California.

None of the many insect and fungus pests are serious enough to discourage planting sugar maple for ornamental purposes. The sugar maple borer kills large limbs and occasionally entire trees by boring under the bark and in the outer sapwood. Similar damage is done by the larva of the leopard moth. The white grub of a twig pruner occasionally mars the trees and litters the ground by cutting off twig ends in the early autumn. Tent caterpillars, white marked tussock



Above: The five-lobed leaf with as many main ribs concentrating at the stem or petiole grow in pairs on the twigs. Below: Two winged seeds are attached to form a key or samara. Right:

Winter buds, opposite one another, are tinged with purple

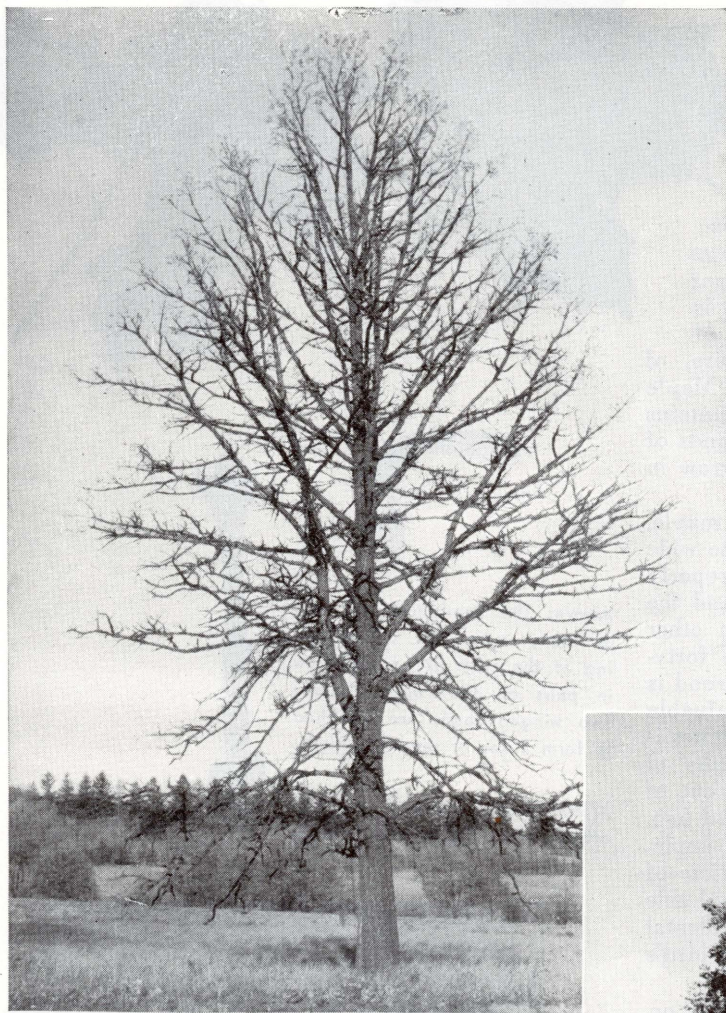


The ash-gray bark breaks up into hard, flinty flakes

moths and a green-striped maple worm may work on the leaves but seldom consumes all of them. Other insidious insect enemies are the scales which attach themselves to the young tender bark. Borer attacks may be met by pruning and burning the affected parts in the spring, while the leaf eaters and scales can be controlled by spraying.

BUR OAK

Quercus macrocarpa, Michaux



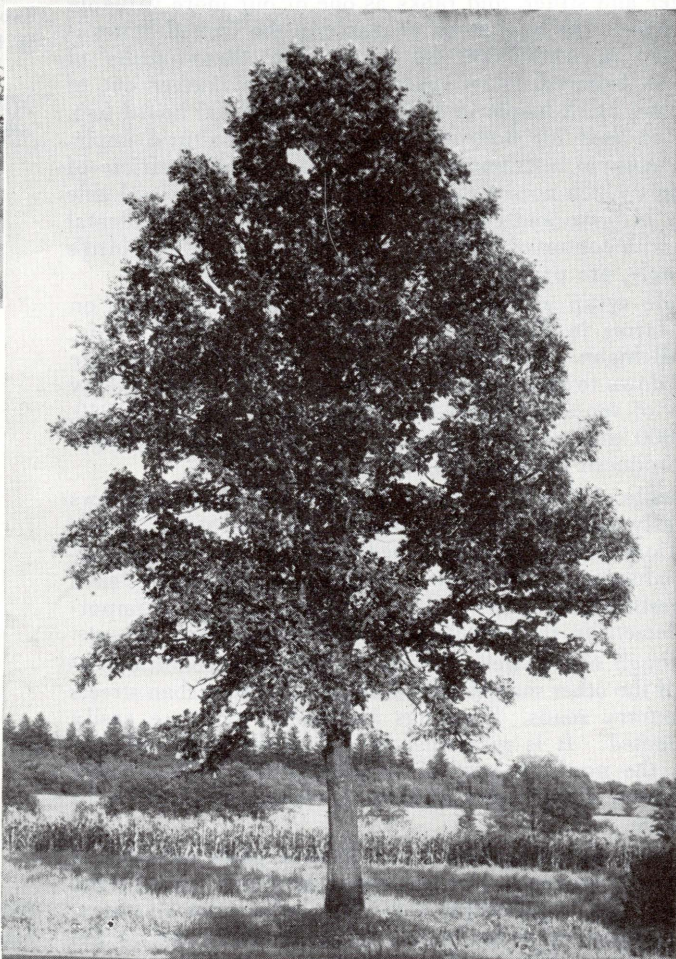
George J. Baetzhold.

BUR OAK is one of the largest, and next to the white oak, the most majestic of American oaks. It is characteristic of the Middle West but grows with surprising adaptability over much of the eastern half of the United States from the Turtle Mountains and Black Hills of the Dakotas, south to the Nueces River, of central Texas, east through Tennessee and West Virginia into Maryland and Delaware to the Atlantic, and north into southern Manitoba, Nova Scotia, and New Brunswick. It attains greatest size and highest commercial importance in the Wabash River Basin, of Indiana and Illinois. Typical of the "oak openings" of the Lake States, it is the most common oak of Kansas and the Prairie States.

Open grown trees develop an irregular broadly rounded crown with stiff, gnarled branches and stout, frequently crooked, corky-winged branchlets. Ordinarily seldom over eighty feet high or three feet in diameter, trees 170 to 180 feet high and six or seven feet in diameter have been reported. Under forest conditions it develops a tall, massive, clear trunk which supports a moderately broad, open crown of stout

branches. In contrast to these splendid dimensions it may, on unfavorable sites live for years in thickets without attaining heights of more than six to eight feet. Under such conditions it is frequently referred to as "scrub oak."

The rounded, lobed leaves, wedge-shaped at the base, are the largest of all the oak leaves, being six to twelve inches long and three to six inches broad at the upper half. Two unusually deep wide bays or sinuses dip in near the middle of the leaf toward the stout pale midrib, which is occasionally hairy on the upper side. The five to seven rounded lobes are irregular, and the terminal one, occupying more than a third of the entire leaf has irregularly crenate margins. Crowded to the ends of the twigs are thick firm leaves, lustrous dark green above but silvery green and downy below. They turn dull yellow in the autumn, and do not hang on into the winter as do those of many other oaks.



George J. Baetzhold

With its characteristic irregular broadly rounded crown and gnarled branches, the Bur Oak is one of the largest and most majestic of the American oaks. It never grows in dense stands, but individually or in groups

In May or June the blossoms of both sexes appear as the woolly leaves unfold. The staminate or male blossoms comprise slender, yellow-green, hairy catkins from four to six inches long. On the same tree, and frequently on the same branches will be found the reddish, hairy, pistillate flowers growing without a stalk, or so close to the twig as to have only a very short one.

Being of the white oak group, the fertilized pistillate flowers develop by autumn of the first year into short-stalked, broadly egg-shaped acorns, from three-fourths of an inch to two inches long, and more than half surrounded by a deep scaly cup. This cup with its fringe of coarse elongated scales is responsible for the common names, bur oak, and mossy cup oak. Prolific crops of highly fertile seed are borne at frequent intervals. Their vitality is retained for six months to a year, with the result that seedlings are easily produced during the following spring on moist fertile soil. A strong tap root makes transplanting the seedlings difficult unless they are root pruned at an early age.

The scientific name *macrocarpa*, meaning large fruited, refers to the large nut whose sweet, white kernel is edible. The acorns of southern grown trees are usually larger than those of the North. *Quercus* is the Latin name for all the oaks, and is said to have been derived from the Celtic *quer*, meaning fine, and *cuez* meaning tree. The scientific name describing a fine tree with a large fruit is peculiarly apt in the case of bur oak.

The flaky, grayish to reddish brown bark of old trees is one or two inches thick, cut by deep fissures into firm, more or less vertical ridges. Resembling that of white oak, the bark is firmer and the ridges are usually more prominent. First year branchlets are covered with greenish gray bark, turning to a light orange color, and covered for a short time with fine hairs. Later these twigs become dark brown and develop corky ridges or wings often an inch to an inch and a half wide. As the limbs mature, sections of bark are cast off to litter the ground below.

The light brown, close-grained, hard, tough heartwood with conspicuous medullary rays so resembles that of white oak that it is frequently classed with that species on the market. Under air dry conditions a cubic foot weighs about forty-five pounds, which is only two or three pounds lighter than the wood of white oak. No figures are available to show this country's existing stand of bur oak as distinguished from white oak. It is used for furniture, interior finishes, vehicles, moldings, and veneers. Because of its durability in contact with the soil it is frequently used for railroad ties and structural material.

Bur oak never grows in dense stands, but as individuals or in groups associated with other bottomland trees such as pin oak, white oak, basswood, willow, cottonwood, black walnut, the hickories, elms, and soft maples. It grows well on rich, moist bottomlands and on lower slopes, preferring areas where water is available but not excessive.

Of relatively slow growth, it reaches great ages and is not considered mature before 200 to 300 years.

Because of the damp sites on which it grows, fire damage is rare, while it is seldom injured by either insects or fungus diseases.

The sturdy unsymmetrical beauty of bur oak, its remarkable ability to withstand damage from city smoke as well as its freedom from insect and fungus injuries, its adaptability to soils and climates, and the comparative ease with which it may be raised and transplanted recommend it for use on streets and lawns.

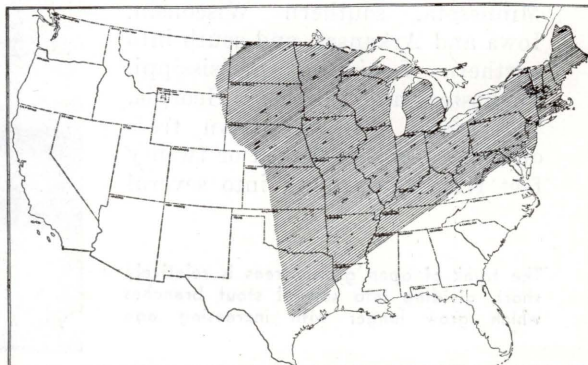


George J. Baetzholt.

The rounded, lobed leaves of the Bur Oak, wedge-shaped at the base, are the largest of all the oak leaves, being from six to twelve inches long and three to six inches broad at the upper half. The acorns are short-stalked, and broadly egg-shaped



The flaky, grayish to reddish brown bark of the older trees is from one to two inches thick, cut by deep fissures into firm, more or less vertical ridges. Resembling that of the white oak, the bark of the Bur Oak is firmer and the ridges are usually more prominent



Natural range of Bur Oak in the United States

NORTHERN RED OAK

Quercus borealis, Michaux

THE OAKS are naturally divided into two groups—white oaks and red or black oaks. The latter make up a little more than half of the

stout branches. In the forests, the trunk assumes greater length and carries a narrow, round-topped crown. Some trees in the Ohio Valley and the mountains of West Virginia, Kentucky, Tennessee, and North Carolina reach 150 feet in height and six feet in diameter, but more ordinarily it is seventy to ninety feet high and two to three and a half feet in diameter.

This description combines the two more important and frequently confused red oaks of the North—*Quercus borealis* and the larger *Quercus borealis maxima*. *Borealis*, meaning northern, refers to the range of the species, while *maxima*, or largest, distinguishes this particular variety of oak, whose tree as well as acorn are the biggest of all the black oak group. *Quercus* is an ancient Latin name, probably of Celtic origin, meaning “beautiful tree.”

The simple alternate leaves



Louis Boeglin

The broad, symmetrical crown of dark green foliage and thick, short trunk combine grace and strength in Northern Red Oak

total stand of the oaks while the quantity of northern red oak is about eight percent of the total.

The broad symmetrically spreading crown of dense dark green foliage is a conspicuous part of the landscape throughout the entire northeast—as far west as central Minnesota, southern Wisconsin, Iowa and Arkansas, and south into northern Louisiana, Mississippi, Tennessee, and northern Georgia. The trunk of open grown trees often separates at fifteen or twenty feet from the ground into several

The trunk of open grown trees is relatively short, dividing into several stout branches which grow longer with increasing age



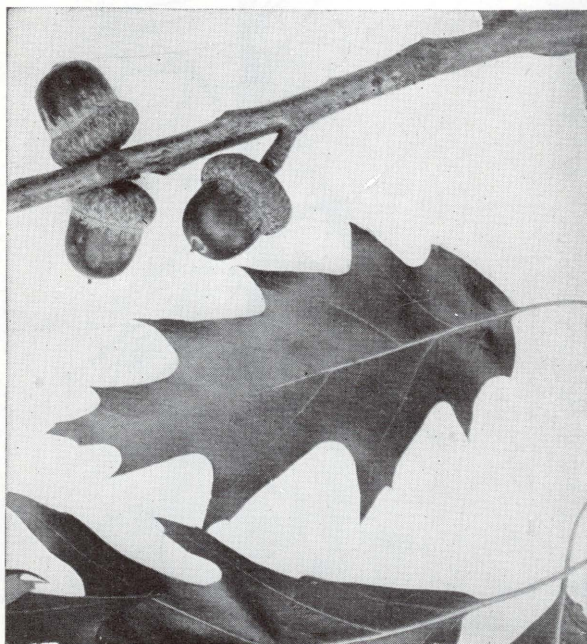
Louis Boeglin

have five to eleven unequal bristle-tipped lobes tapering from broad bases. They are five to nine inches long, four to six inches broad, dark green above, and paler green beneath. Appearing late in spring, by autumn they turn deep red or orange to hang on until late fall or winter.

Flowers of each sex appear on different parts of the same trees in May or June with the unfolding leaves, when the long hairy staminate catkins seem to veil the entire crown. The less conspicuous, greenish pistillate blooms develop into single or pairs of short-stalked acorns. They are fertilized by wind-borne pollen from the staminate catkins of the neighboring trees, and take two years to mature into broadly oblong, reddish brown acorns, an inch or more long with a diameter only a little less. Each acorn rests in a flat saucer-shaped cup whose narrow border is covered with small closely fitting scales. The dark gray to reddish brown bark of mature trees is a half to three-quarters of an inch thick, and has a light reddish or flesh colored inner bark.

The strong close-grained wood is light reddish brown in color with a thin layer of lighter colored sapwood. A cubic foot weighs about 45 pounds when air dry. It is used for general construction, flooring, interior finish, cheap furniture, railroad ties, posts, poles, and fuel. In 1946 a lumber cut of about 3,000,000,000 board feet was reported for all species of the red oak group.

Red oak reproduces itself by stump sprouts or coppice, as well as from seeds. It grows in company with other oaks, sugar maples, elm, white pine, and the hickories, and is the most rapid growing of all the oaks.



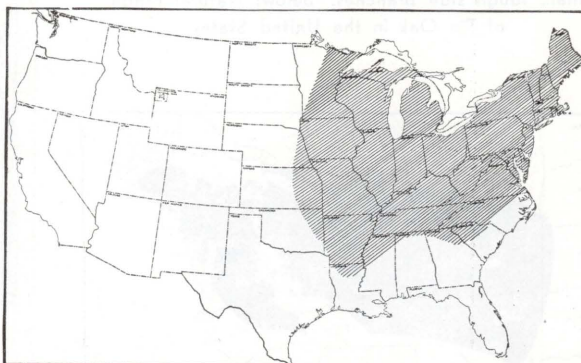
The dark green leaves are five to nine inches long with unequal bristle-tipped lobes, while the shallow-cupped, reddish brown acorns are broadly ovate



Slender, pendulous catkins of pollen-bearing flowers are borne late in the spring along with the unfolding leaves



The dark gray to reddish brown bark is broken into broad, flat topped ridges



Natural range of Northern Red Oak in the United States

PIN OAK

Quercus palustris, Muenchhausen

PIN OAK is more widely known as a street or ornamental tree than for lumber purposes, but grows naturally from southern Arkansas and north central Mississippi northward to southern New England and New

York. The westward distribution extends to southern Michigan and Wisconsin, eastern Iowa, Kansas and the Oklahoma Ozarks. Pin oak usually occupies poorly-drained flats, low clay ridges, edges of swamps, and occasionally very moist upland sites. One common name, swamp oak, corresponding with the scientific name *palustris*, is derived from the Latin word *palus* meaning swamp. *Quercus* is reported in "Tree Ancestors" by Berry, to be derived from the Celtic *quer* or fine, and *cuez* or tree. So it may be said that this is the fine tree of the swamp. The common name, pin oak, refers to the great number of short, spur or pin-like branchlets on the main branches, or to the remnants of dead branches which extend through the wood to the center of the trunk.

Pin oak is a tree of moderate size, rarely exceeding eighty-five or ninety-five feet in height, and three feet in diameter. Occasional forest-grown specimens reach a height of one hundred

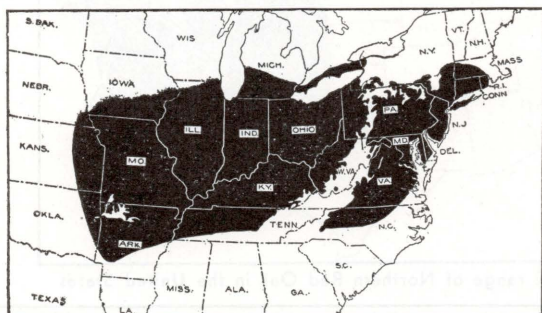


G. H. Collingwood

Pin Oak develops a single central trunk with relatively small side branches which support a dense crown of glossy green leaves. The same tree shown in winter reveals (lower right), the small, tough side branches. Below: Natural range of Pin Oak in the United States



G. H. Collingwood



and twenty feet, with a trunk four or five feet in diameter. Its straight trunk extends well up into a symmetrical, pyramidal crown whose tough drooping branches frequently sweep the ground. With increasing age the crown loses its original pyramidal shape and becomes broad and rather open.

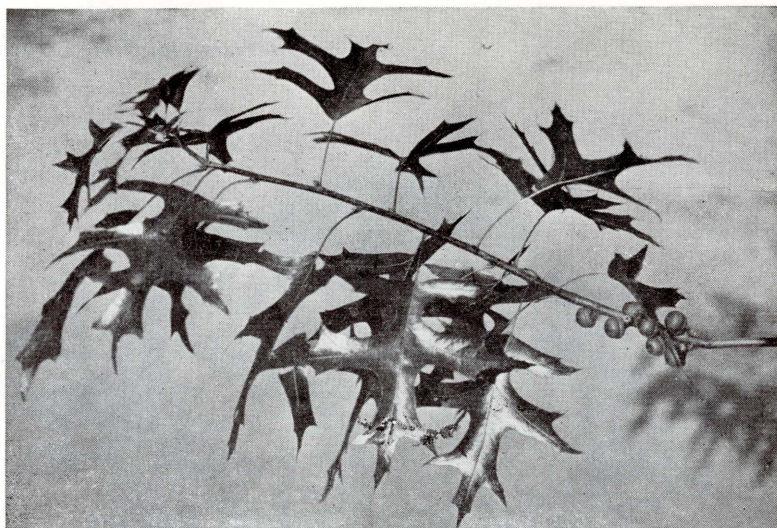
The bark is light to dark grayish brown, hard, so close as to appear tight, from three-fourths of an inch to one and one-fourth inches thick, and divided by narrow, shallow fissures into broad, low, scaly ridges. The five to nine-lobed narrow leaves are four to eight inches long, thin, firm, dark green and lustrous above, paler beneath, and perfectly smooth except for tufts of pale hairs in the axils of the larger veins. They have slender stems or petioles, one-half of an inch to two inches long, and the irregularly toothed lobes taper to narrow, pointed ends.

Male and female blossoms are borne separately on the new wood of the same tree. The male or staminate flowers appear with the leaves in early spring as brown tassels, while the less conspicuous pistillate flowers may be found at the angle where the new leaf joins with the main stem. The reddish brown acorns are broader than long and set close on the main stem in flat, saucer-shaped cups. They take two years to mature, and are set singly or in clusters on the two-year old branches.

Pin oak has no special commercial importance, but, although generally inferior, is cut and marketed as red oak wherever found in ordinary logging operations. The numerous small adherent limbs cause excessively knotty logs, and the heavy, hard wood checks badly in drying. Accordingly, only the best trees are cut for lumber. It is used for flooring, small fixtures, handles and for other purposes normally filled by red oak, and also for ties, car stock, piling and railroad material.

The upright pyramidal crown, lack of heavy side branches, clean trunk and rich glossy leaves make it one of the most desirable oaks for street and ornamental planting. A fibrous root system without a distinct tap root gives ease and security to transplanting. When planted in well drained moist soils it grows rapidly, produces a dense shade, and with relatively little pruning does not interfere with street traffic. Best results are secured when the trees are planted about forty feet apart.

Aside from attacks by the obscure scale, which resembles the San Jose scale, pin oak is especially free from injury by disease or insects, but fire frequently damages trees growing in the woods or on large estates. The obscure scale can be controlled by spraying with lime-sulphur or miscible-oil solutions in the early spring before the leaves appear and again in midsummer.



G. H. Collingwood

The deep-cut, glossy, dark green leaves have five to seven lobes terminating in irregular points. The small, brown acorns are set in shallow, flat cups and mature on wood of the previous year



G. H. Collingwood

Low, scaly ridges and an appearance of tightness help characterize the dark gray bark of mature Pin Oak trees



G. H. Collingwood

Before the spring leaves have reached full size, the tree is decked with tassels of pollen-bearing staminate flowers. The inconspicuous pistillate flowers are hidden within the axils of the leaves

BLACK OAK

Quercus velutina, La Marck



Devereux Butcher

An open-grown Black Oak develops an irregular and wide-spreading crown of large ascending branches

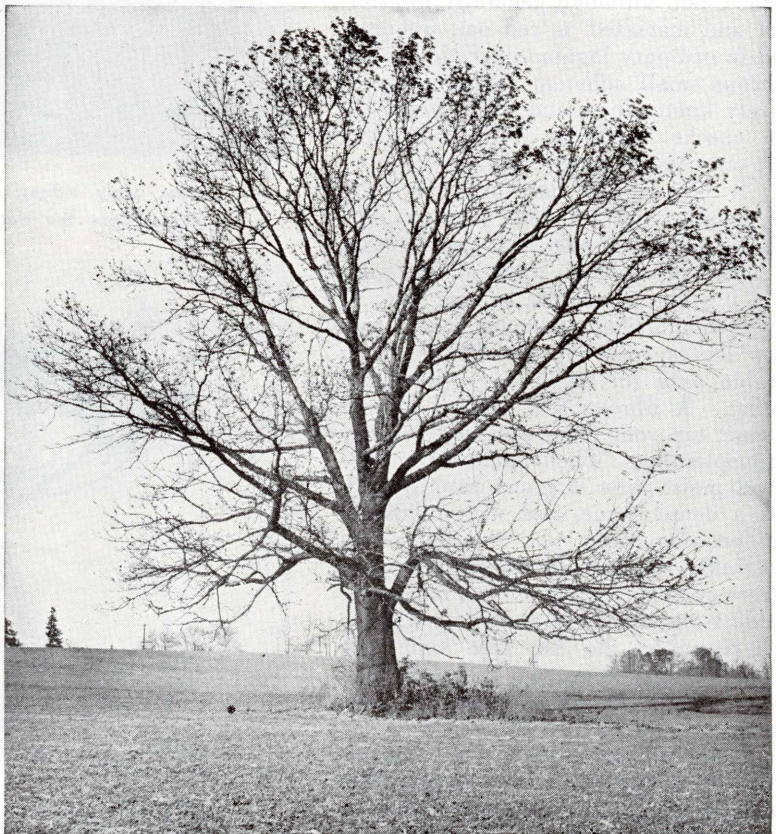
ONE of the commonest and largest of the eastern oaks is black oak which varies greatly as to form in different localities. Average height is from sixty to eighty feet with trunk diameters from two to three feet, and under favorable conditions, particularly in the lower Ohio basin, sometimes a hundred and fifty feet with a trunk diameter of four or five feet. In general habit black oak is similar to scarlet oak, but the limbs are usually somewhat stouter. On good sites the bole is long with little taper, occasionally free of limbs for forty feet, while on less favorable soils the trunk tapers excessively and limbs grow closer to the ground.

The name, *Quercus*, is Latin for oak and means "beautiful tree"; *velutina* comes from the word *vellus* which means fleece and refers to the surfaces of the leaves which are velvety when young; also, perhaps, to the downy winter buds.

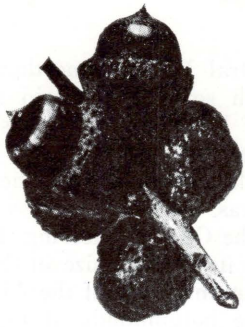
The range of black oak extends from southern Maine and northern Vermont westward through southern Ontario, southern Michigan to southeastern Minnesota, and south to

northern Florida, west to eastern Texas, eastern Oklahoma, eastern Kansas, southeastern Nebraska and Iowa. In upland cutover forest areas it is the most abundant species, and though it prefers rich, well-drained, gravelly soils, black oak is not usually found in great abundance in the better soils because it is very intolerant to shade, and unable to compete with other species. It is most often found on the poorer soils of slopes and ridges, the young trees developing long taproots that enable them to survive where many species would suffer for want of water. The most common associates of this tree are the other oaks, occasionally ash and yellow poplar.

Bark on the mature trunk is dark gray or almost black, often paler gray in the coastal regions, three quarters to one and a quarter inches thick. Bark on young trunks and on branches is warm gray and smooth; inner bark is deep orange, very bitter to taste and is rich in tannin. From the deep orange inner bark a yellow dye commercially known as quercitron is made.



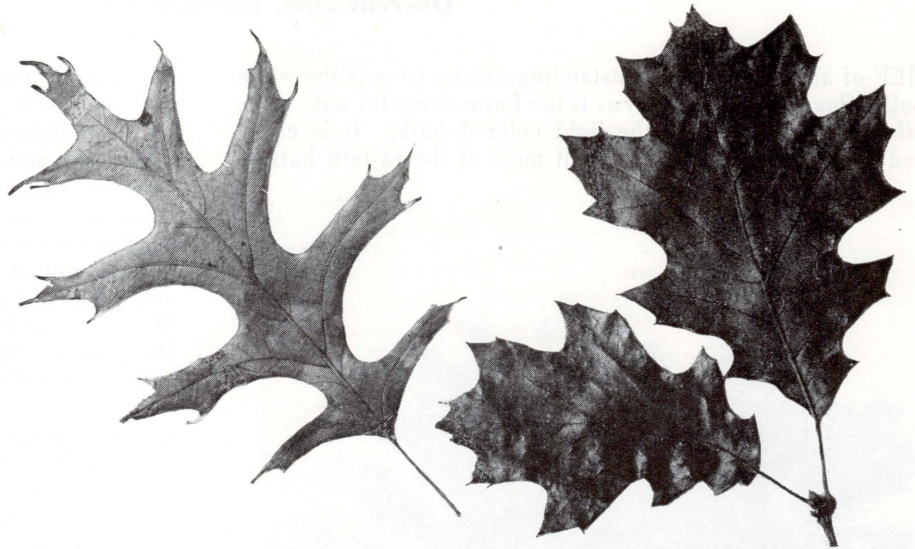
Devereux Butcher



J. B. Sudworth

Acorns measure one-third to three-quarters of an inch long, and are held by deep, thin-scaled cups

Black Oak leaves, more varied than those of any other oak, usually have seven lobes



The stout, smooth, or slightly hairy twigs of black oak are dull red-brown, later turning dark brown, and have large lenticels or pores. The lateral buds are alternate, those near the ends of twigs clustered about the terminal bud; they are yellowish gray, measuring one quarter to one half inch, are sharply pointed, and usually five-sided. The down with which they are covered offers a means of identifying this oak from others in the black oak group.

The alternate leaves measure five to six inches in length and three to four inches in width. They are bristle-tipped as are the leaves of all oaks in the group. Their indentations are deep, rounded and wide, extending at least halfway to the midrib. The mature leaf is thick, tough, smooth, dark green, and very shiny above, paler and somewhat hairy or smooth beneath, with brown hairs at the connections of the main veins. The yellow stout stems are two to six inches long.

In May or June, when the new leaves are half grown, the flowers appear. Borne on the growth of the preceding season, the pollen-bearing ones occur in hairy catkins, four to six inches long, while the seed-producing ones, growing at the bases of the leaf-stems of the season, are reddish and borne on short, hairy stems. Ripening from October to November of the second season, the acorns are either stemless or on short stalks. The yellow, bitter kernel is not edible. Crops of acorns are produced every two or three years. Black oak is fairly prolific and germination is frequently eighty percent or over. The approximate maximum age of black oak ranges from a hundred and fifty to two hundred years.

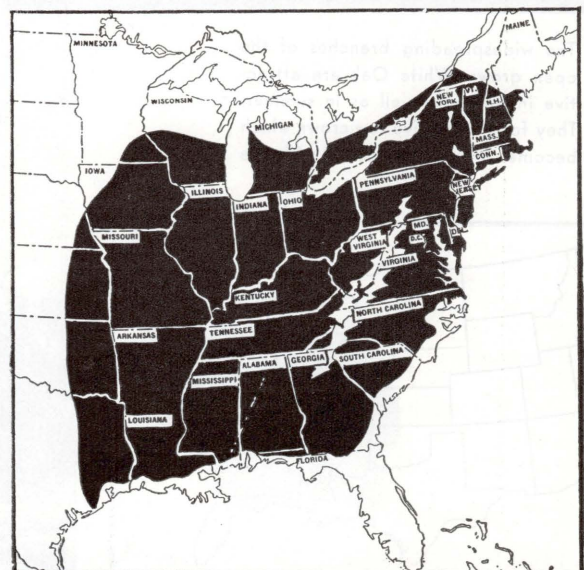
Black oak wood is heavy, hard, strong, not tough, coarse-grained, checks in drying, and has fewer and smaller medullary rays than the wood of most other oaks. Heartwood is reddish brown, the sapwood narrow and pale. A cubic foot when seasoned weighs 43 pounds. Most important of the black oak group, it makes up in quantity about fifteen percent of the stand of all the oaks. It is used for cheap furniture, slack cooperage, flooring, construction, interior finish and fuel. It is not easily worked.

The healthy tree is not usually severely attacked by insects or borers. Black oak is seldom planted as an ornamental tree.



R. C. Brundage

Bark on large trunks is broken by deep furrows into ridges that are transversely cut into block-like strips



Natural range of Black Oak

WHITE OAK

Quercus alba, Linnaeus

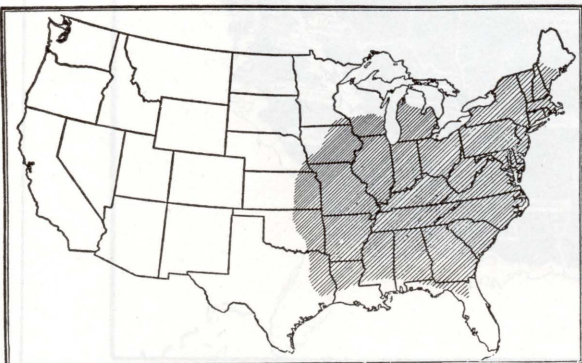
CHIEF of all the oaks and outstanding among trees is the white oak, [*Quercus alba*]. *Quercus* is the Latin name for oak, while *alba* possibly refers to the light colored bark. It is easily recognized and is a favorite throughout most of the eastern half of

the country from central Maine to northern Florida, and west through southern Ontario and the southern Peninsula of Michigan, through southern Wisconsin and Minnesota, most of Iowa, eastern Nebraska, Kansas, Oklahoma and along the Brazos River to southern Texas, excluding only a narrow coastal region along the Gulf. Preferring rich well drained soil, it attains its greatest size in the coves and valleys of the western slopes of the Allegheny Mountains and in the bottomlands of the lower Ohio Basin. There it attains a height of 150 feet and occasionally six or eight feet in diameter, but is more commonly sixty to eighty feet high. Individuals have been known to be 800 years old.

While trees grown in the deep woods are tall and narrow crowned, as compared with the broad round heads of open grown trees, the pale gray bark with shallow fissures and scaly ridges is usually characteristic. The bark on old trees may be two inches thick. The leaves are alternate, from five to nine inches long, narrowed toward the stem, somewhat oblong in outline but usually with the broader end forward, and with seven to nine smooth-margined finger-like lobes. They turn russet in the fall and hang on through much of the winter. The buds are round and smooth, clustered at the tips of the twigs so as to give the effect of a clenched fist. In cross-



The widespread branches of the open grown White Oak are attractive in winter as well as in summer. They form a massive low crown which becomes increasingly broad with age



Natural range of White Oak in the United States

section a twig reveals a five pointed star-like pith.

In May, when the new rose colored leaves are scarcely one-third grown the fringed catkins of the staminate flowers and tiny close fitting clusters of pistillate flowers appear. The acorns mature during the early autumn of the same season. Accordingly, white oak carries no acorns during the winter. The shiny, brown nut is three-fourths of an inch to an inch long and set about one-fourth its length in a shallow cup which is attached directly to the twig or by a very short stem. Squirrels, other mammals and birds enjoy the sweet flavored nut so that comparatively few sprout into seedlings. The early colonists learned from the Indians ways of boiling and preparing them for food.

The light brown wood weighs about forty-eight pounds to the cubic foot when air dry, which is nearly twice the weight of white pine. Its uniform strength, narrow growth rings, durability and attractive color encourage a wide variety of uses, ranging from fine cabinet work and interior trim to flooring, railroad ties, piling, barrels, veneers, bridges, ships and building construction. Originally desired for its strength and durability, its beauty for furniture, floors and interior trim is now of first importance. Quarter-sawed oak reveals large numbers of "mirrors," which are the split medullary or pith rays. These form a pattern prized for many purposes. Tannic acid in the wood protects it from some fungi and insects, but results in unsightly discoloring when iron nails are used on exposed surfaces.

Recent estimates show a present stand of merchantable oak sawtimber totaling 101,381,000,000 board feet. The stand of the white oaks as a group is believed to make up a little less than half of this, while the stand of white oak (*Quercus alba*) is about a fifth of the total oak stand. Of the 4,300,000,000 board feet of oak lumber cut in 1946, 1,360,000,000 board feet was reported as white oak, including all species of that group. The largest supplies of both the white oaks and red oaks are in the southeast, principally in the Deep South. Louisiana, Arkansas and Mississippi contain more than one-fourth of the total stand.

White oak has few natural enemies and the worst of them is fire. The oak timber worm or pin worm is destructive to timber values, a twig pruner causes owners of shade trees to be alarmed but is seldom fatal, and the gypsy moth may prove serious within its limited range. Several fungi cause heart rot. Fire and gypsy moth may be controlled and injuries caused by these enemies are often responsible for other difficulties.

Little attention has been given to propagating white oak either for ornamental or forest purposes. This may be due to its slow growth and the strong tap root which makes transplanting difficult, but white oak is splendidly adapted for city streets, home lawns and parks. The broadly spreading branches form a round top more than eighty feet high and fully as broad. For best development the young trees should be planted about forty feet apart, and eventually thinned to about eighty feet to give room for maximum crown development.

The acorn is the principal means by which the white oak tree reproduces itself, but under favorable conditions it will sprout from the stump. Seedlings may be grown in nurseries and transplanted, or the acorn may be planted where the tree is desired.

Glossy leaves with five to nine rounded lobes and sweet-meated acorns whose shallow cup covers a fourth of the nut are characteristic



Pollen-bearing staminate blossoms appear in May when the first leaves unfurl. Inconspicuous pistillate blossoms from which the acorns develop are at the base of the new leaves

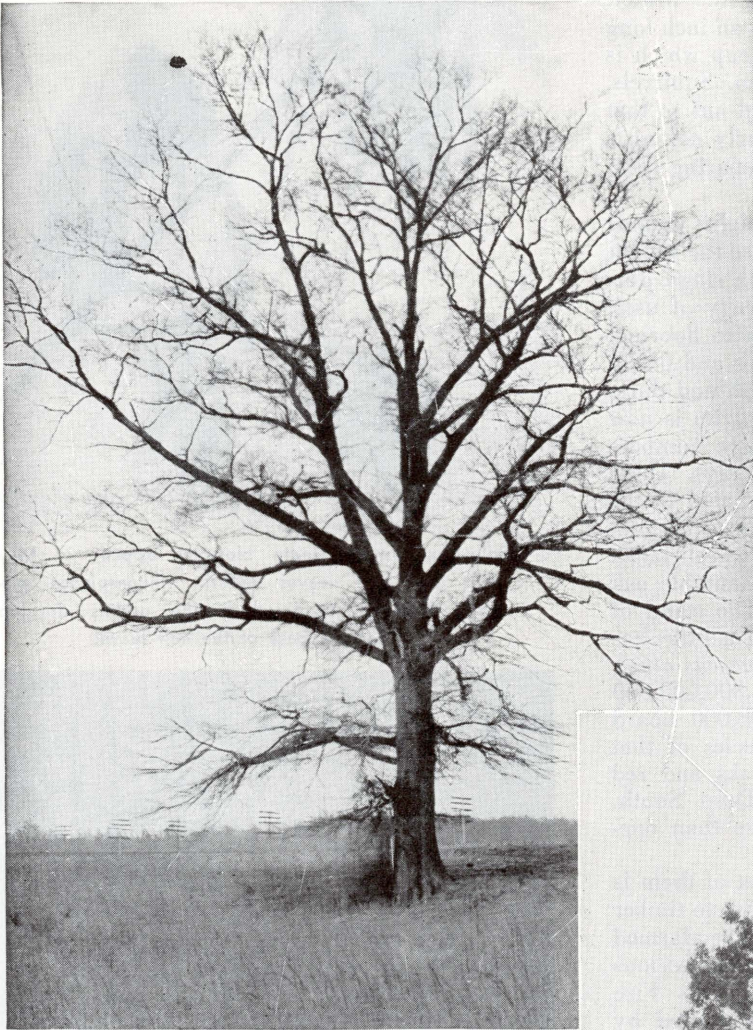


Light ash-gray bark with scaly plates and shallow fissures help distinguish the older white oak trees



WILLOW OAK

Quercus phellos, Linnaeus



Maryland State Department of Forestry

Willow Oak has a strong central trunk supporting numerous side branches from which grow many small spur-like branchlets, resembling those of the pin oak

WILLOW OAK lays no claim to size or majesty, but its round-topped symmetrical crown, rapid growth and long life place it among the most attractive of the red oak or black oak group. Occasionally, in the moist fertile portions of its southern range it attains heights of 100 to 120 feet and diameters at breast height of three to five feet. Over most of its range, however, it is usually forty to fifty feet high with a full clear trunk fourteen to twenty inches in diameter, frequently rising intact through the crown. The side branches are slender like those of the pin oak and the lower branches droop or dip down at the ends. The side branches persist except in dense shady stands.

Under forest conditions it develops a tall, straight trunk and a full symmetrical crown. The trunk prunes itself slowly, leaving many small live and dead branches which form

knots in the wood and greatly reduce the clear merchantable length.

It thrives on poorly drained bottomlands that are normally covered each winter with shallow water, occurs in rich moist soil along the margins of streams and swamps, and also on higher land. It grows from southern Long Island and Staten Island in southeastern New York chiefly along the maritime plain to northeastern Florida, through the Gulf Region to the Sabine River Valley in eastern Texas and north through eastern Oklahoma, Arkansas, southeastern Missouri to central Tennessee, southern Illinois and eastern Kentucky. Reaching its largest size and greatest abundance in the lower Mississippi Valley, it grows in company with other oaks, hickory, tuliptree, maple and elm. It is so frequently found along wet margins of streams and swamps as to be erroneously known as swamp oak, or water oak. The abundant short spur-



The full, round, slightly conical crown of Willow Oak is frequently forty to fifty feet high and may attain a height of one hundred feet or more

like branchlets on the lower branches have led to wide use of the name pin oak.

Willow oak gets its name from the long, narrow, lance-shaped or occasionally scythe-shaped vivid light green leaves, which in shape as well as color resemble those of a willow more than an oak. In texture, however, they are thicker and more leathery. They are pointed at both ends, two and one-half to five inches long with a short stem or petiole and a slender yellow midrib. The shiny light green of the upper side is mildly contrasted by a lighter green below. In the South the tree is nearly evergreen, and the leaves never attain the bright autumnal colors of the red, pin and scarlet oaks but turn a pale yellow before falling. The long narrow entire leaf, which is common to only a few other oaks, leads occasionally to the common name—peach-leaf oak. Willow oak may be confused with the water oak, [*Quercus nigra*], the laurel oak, [*Quercus laurifolia*], and with shingle oak, [*Quercus imbricaria*]. The leaves are smaller, narrower, without hairs on the under surface, and of almost uniform width. The acorns of laurel oak are larger and the cups not so flat as those of willow oak.

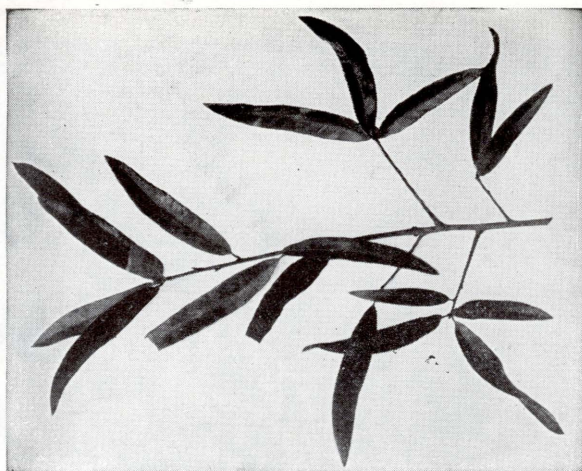
The flowers are each of a single sex and are found on all parts of the tree—the male catkins on last season's growth and the female flowers in the axils of the new leaves. They appear in late March in the South. Farther north they appear in April or May and continue in evidence for two or three weeks. The pollen from the staminate blooms, which are like yellow-green knots along the two to three inch stems, is carried by the wind to fertilize the pistillate flowers. These stand on short, slender, smooth stalks or peduncles at the base of the leaves. Characteristic of the red oak or black oak group, it is the fall of the second season before they mature into hemispherical, light yellow-brown acorns about a half inch long set less than a quarter of their diameter in a thin saucer-shaped cup. This in turn is covered with thin elongated scales, and the inside is lined with a mat of fine, white hairs. The acorn is held to the twig by a short stalk, and the meat is bitter with tannin.

Dark, chestnut brown, narrowly conical winter buds about an eighth of an inch long and without angles are borne alternately on smooth, slender, reddish brown twigs marked with dark lenticels or breathing pores. Each of the numerous, well defined bud scales is edged with pale gray or white.

The red-brown to steel gray bark is a half to three quarters of an inch thick, generally smooth and very hard. On large mature trees it is nearly black, broken into rough, hard ridges and irregular plates by narrow fissures. *Phellos* comes from a Greek word referring to cork and was used to refer to the oak long before the name was accepted by Linnaeus. It has no reference to any special corky quality of the bark.

The strong, heavy, close-grained wood is reddish brown and resembles that of red oak, with which it is most frequently marketed. In the Mississippi delta region it is of considerable commercial importance but there are no reliable estimates of the available stand of this species. It weighs about forty-five pounds to the cubic foot when air dry. This is about the same weight as white oak, but its strength is only eighty-six percent of that wood. It is used for interior trim, house frames, doors, floors, slack cooperage, and railroad ties.

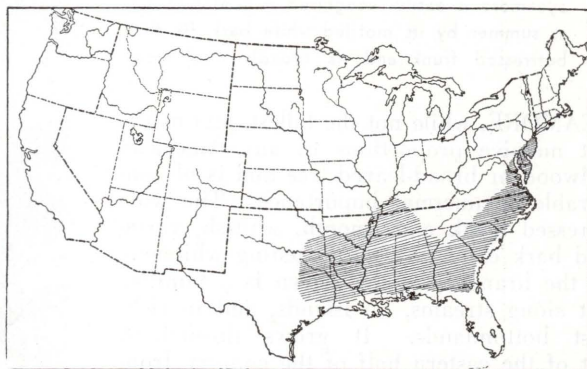
Willow oak is hardy as far north as Massachusetts and in the South Atlantic and Gulf States is recognized as one of the best of the quick growing trees for street, and ornamental planting. The comparatively shallow



The narrow light green leaves, two and one-half to five inches long and pointed at each end, resemble those of a willow more than an oak

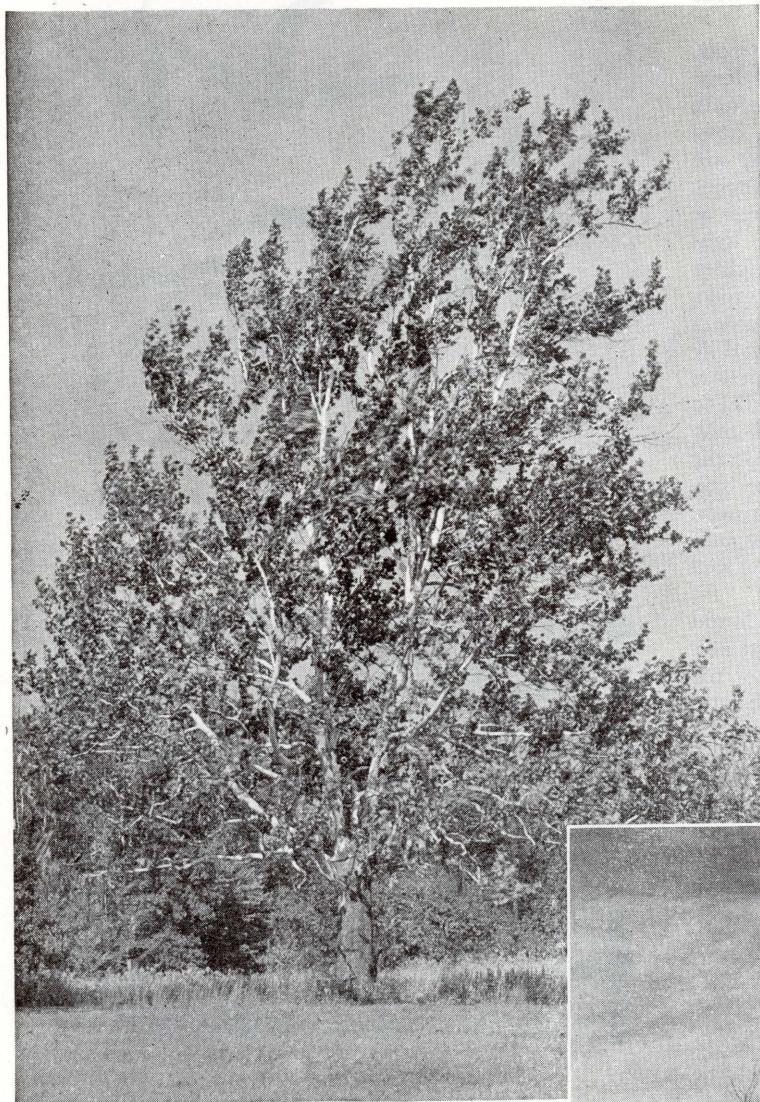


The relatively smooth brown to dark gray bark is one-half to three quarters of an inch thick



Natural range of Willow Oak in the United States

root system helps make it easily transplanted. Trees twelve to fifteen feet high may be dug from the woods and successfully grown but well rooted nursery-grown stock is more satisfactory for ornamental planting. Although with few enemies, trees are occasionally seriously retarded by scale insects which feed on the tender bark of twigs and small branches.



George J. Baetzhold

Sycamore is easily recognized in winter as well as summer by its mottled white bark, its thick buttressed trunk and its broadly oval crown

SYCAMORE, while not the tallest, attains the most massive proportions of any American hardwood or broad-leaved tree and is of considerable commercial importance. The wide buttressed trunk and smooth, whitish, variegated bark extending its glistening whiteness into the branches of the crown is a familiar sight along streams, on islands, and in rich, moist bottomlands. It grows throughout most of the eastern half of the country from southern Maine to northeastern Nebraska, south into Texas and along the Gulf of Mexico to northern Florida.

Averaging sixty to one hundred and twenty feet in height and two to five feet in diameter, individuals 140 feet tall and up to fourteen feet in diameter have been recorded. As the tree attains maturity the trunk becomes irregular and eccentrically buttressed. From the relatively short, rapidly tapering trunk of open grown specimens, large, widespreading limbs extend to form a broad irregular crown

occasionally one hundred feet or more across. This form gives way under forest conditions to a slightly tapering trunk whose clear length of sixty feet or more supports a relatively small crown.

The simple, alternate, palmately veined leaves are roughly three to five-lobed, with occasional coarse teeth. It is the largest single-bladed leaf native to the American forest, being four to ten inches long and equally broad. Bright green on the upper side, paler beneath but without hairs, the leaves have a leathery texture. At the base of the stout one- to two-inch leaf stem or petiole is a flaring ruffle-like stipule, while the entire stem is finely coated with hairs and the broad hollow base completely caps and encloses a long, smooth, blunt, conical bud of the coming season.

Inconspicuous flowers of both sexes are borne on the same tree but on different stalks and appear as the leaves unfold in early May. The male flowers are in dark red clusters, borne on a short base, while the small, light green, pistillate or female blooms form closely packed, ball-like heads attached to a long, slender, thread-like stem. By October these develop into a dense ball



George J. Baetzhold

or compound fruit dangling from a long slender stem and after hanging through the winter break up into many hairy, one-seeded nutlets. American sycamore has single seed balls, while those of the Oriental sycamore and London plane, (*P. orientalis* and *P. acerifolia*), hang in pairs or even fours. These seed balls give rise to the common name buttonwood or buttonball.

While sycamore fruits abundantly nearly every year, the vitality is low and the seeds are slow to germinate. Many seeds are carried by the water of early spring freshets and deposited on muddy flats where they germinate in considerable quantities. Even under upland woods conditions, however, the seeds require exceedingly moist surroundings in which to grow. Sycamore sprouts readily from the stump and reproduces itself by this means as well as from seeds.

The bark assumes a variety of forms and colors according to the age of the tree and the conditions under which it grows. Most easily recognized is that of young to moderately old trees in which large, thin plates peel off the trunk, exposing conspicuous areas of whitish, yellowish, or greenish inner bark. This is probably caused by the inability of the bark to stretch as the trunk expands. As trees grow older, the bark becomes two to three inches thick, broken by many shallow fissures to give a scaly appearance, and the light colored mottled look gives way to red-brown or dark gray.

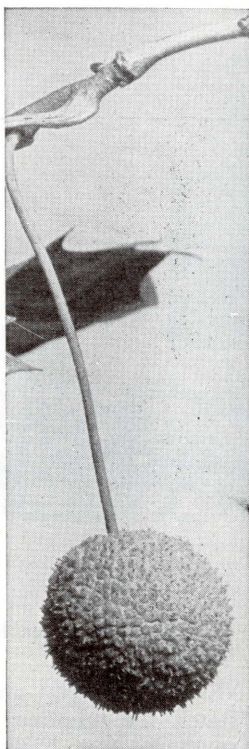
Interwoven fibers make the reddish brown, clean appearing, coarse-grained wood tough and difficult to split or work. It is moderately hard and weighs thirty-five to thirty-six pounds to the cubic foot when air dry. Because it is so easily consumed by decay it is not generally used for railroad ties or fences, but its toughness results in use for butchers' blocks, saddletrees, vehicles, tobacco and cigar boxes as well as for shipping boxes, crates, and slack cooperage. It is also used for musical instruments and when quarter sawn the mottled texture makes it desirable for furniture and interior trim.

Sycamore is scattered through the forests in company with other hardwood trees characteristic of bottomlands. No accurate figures on the stand are available but a rough estimate places the total at 3,000,000,000 board feet. The lumber cut for 1943 was reported as 68,000,000 board feet.

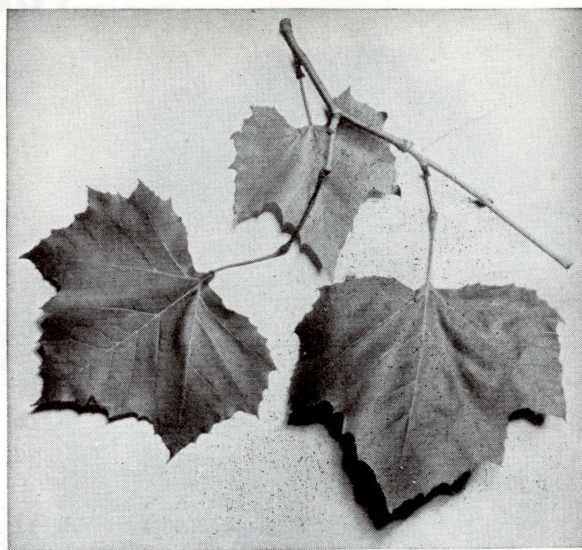
American sycamore belongs to the planetree family and is the most important of six or seven species native to the United States, Mexico and Central America, and one—*Platanus orientalis*—native to south-western Asia.

Platanus is the classical name of the Asiatic planetree while *occidentalis*, meaning western, records it as belonging to the western world, and distinctly an American tree. The family was once world-wide in range and can be traced through geologic evidence to remote times.

Single buttonball fruits, composed of many hairy nut-like seeds hang on a slender stem



George J. Baetzhoid



George J. Baetzhoid

The leaves, frequently broader than long, are palmately veined, four to ten inches across, shiny green on the upper surface and pale beneath



The mottled bark with browns, reds and greens against a background of white, is the result of inability to stretch to meet the expanding trunk



Natural range of Sycamore in the United States

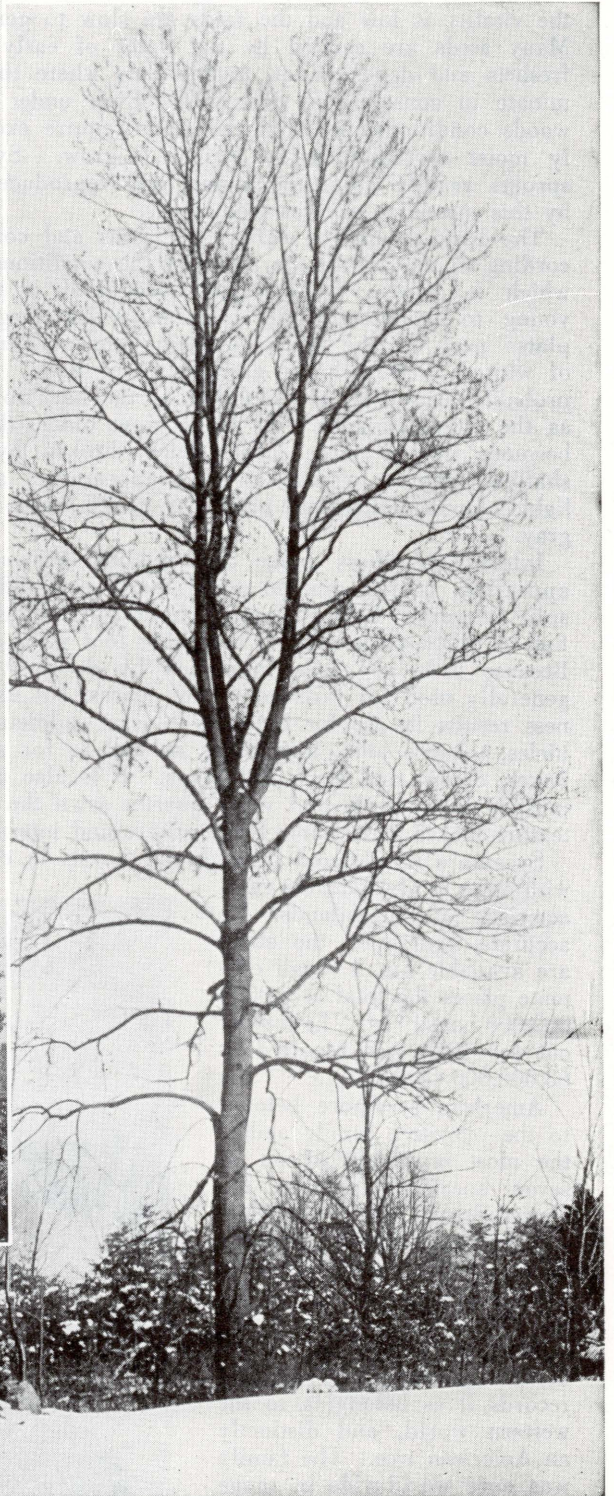
TULIPTREE

TULIPTREE OR YELLOW POPLAR

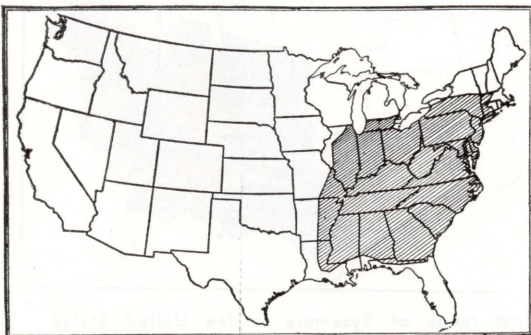
Liriodendron tulipifera, Linnaeus



The Tuliptree in summer foliage, and



in winter, when the upright trunk is revealed



Natural range of the Tuliptree

ONE of the largest and most valuable trees of the eastern states, the tuliptree, is found in the region bounded by southern New England through New York to southern Wisconsin and south to northeastern Alabama and northern

Florida. It reaches its largest size in the deep rich soil of the lower Ohio Valley and in rich sheltered coves and valleys of the Southern Appalachian Mountains, where occasionally it attains a height of over one hundred and fifty feet and a diameter of eight or ten feet. Occasionally the trunk of forest grown trees will be eighty to one hundred feet tall before the first branch. It is always found in mixture with other trees rather than in pure stands as with some of the pines.

In some regions it is known as white-wood, while the Onondaga Indians of central New York called it the white tree, *Ko-yen-ta-ka-ah-tas*.

It is characterized by the clean-cut, glossy, fiddle-shaped leaves, which the botanist describes as truncate, or ending abruptly, as if cut off. This gives rise to the name "saddle-leaf-tree." The large greenish yellow and orange tulip-like flowers develop into dry cone-like fruits about three inches long which remain on the tree after the leaves drop, and from which the winged seeds fall and twirl to the ground. In winter when the leaves have fallen one sees the dark reddish brown buds which are alternate on the branches. The blunt terminal buds are especially noticeable.

The tuliptree belongs to the magnolia family, which is far removed from any of the poplars and cottonwoods, but because of its soft wood it is frequently called yellow poplar. *Liriodendron* is from two Greek words describing a tree with lily-like flowers. *Tulipifera* refers to the tulip-like blossoms. It is a tree of ancient origin and with its close relatives is geologically recorded in Europe and Asia as well as in North America, where it once occupied a wider range.

The sawtimber stand of tuliptree has been estimated at 12,347,000,000 board feet, of which about half is in Virginia, North Carolina, Tennessee and Alabama. The 1946 lumber cut was approximately 790,000,000 board feet, of which 336,000,000 feet came from the Appalachian region and 311,000,000 feet from the South. Georgia and Virginia produce the largest amounts.

The wood is light yellow to brown with a creamy white margin of sapwood. It is soft, easily worked and takes paint well. When air dry it weighs only about twenty-six pounds to the cubic foot. It is used in many kinds of construction, for interior finish, in the manufacture of boxes, crates, baskets and woodenware, for excelsior, veneer wood, and also as a core upon which to glue veneers of other wood. Small amounts are cut for pulpwood to make into paper. Occasionally planks sixty inches or wider are produced.

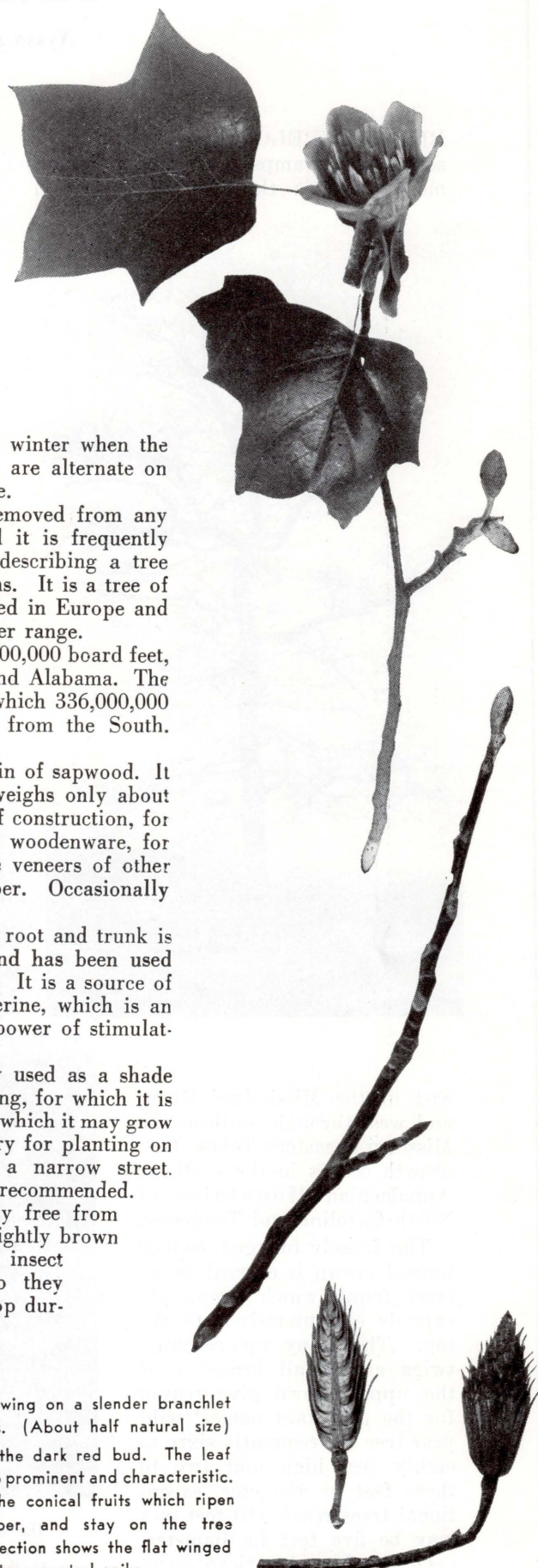
The inner bark of the root and trunk is intensely acrid, bitter and has been used as a tonic and stimulant. It is a source of hydrochlorate of tulipiferine, which is an alkaloid possessing the power of stimulating the heart.

Tuliptree is frequently used as a shade tree and for street planting, for which it is well adapted. The size to which it may grow makes it more satisfactory for planting on wide avenues than on a narrow street. Spring transplanting is recommended.

The tree is moderately free from pests, but frequently unsightly brown spots caused by a gall insect cover the leaves. Also they may turn yellow and drop during the summer.



The deeply furrowed bark of a mature tree is sometimes two inches thick. Bark of young trees is thin and smooth



Above: The tulip-like flower growing on a slender branchlet among the early summer leaves. (About half natural size)

Below is a winter twig showing the dark red bud. The leaf scars, which are alternate, are also prominent and characteristic. Lower down to the right are the conical fruits which ripen late in September and October, and stay on the tree through the winter. The cross-section shows the flat winged seed cases attached to a central spike

BLACK TUPELO

Nyssa sylvatica, Marshall

BLACK TUPELO grows on a variety of soils, in swamps, bottomlands, and moist uplands throughout the region



bers of the genus *Nyssa*, black tupelo is the most widely distributed, and is commercially the most important. *Nyssa* refers to a Greek water nymph, because all tupelos or gums seek the swamps, and *sylvatica* designates this tree as "of the woodlands."

Fossil forms indicate that the genus was once distributed over much of North America, Europe, and Asia. A single species is now found in southeastern Asia.

From April to June inconspicuous greenish, five-toothed flowers on slender downy stems appear among the unfolding leaves. Individual trees bear perfect blossoms, while others bear only staminate or pistillate blooms. By September or October blue-black, plum-like fruits, about half an inch long, are developed, whose thin, oily, slightly acid pulp is attractive to many birds and animals. This may be responsible for the name

east of the Mississippi River, and west through southeastern Missouri to eastern Texas. Best growth occurs in the southern Appalachian Mountains of North Carolina and Tennessee.

The densely foliaged, conical topped crown is carried on an erect trunk which frequently extends continuously into the top. The many up-reaching twigs and small branches of the upper crown give reason for the mountain name "wild pear tree." Frequently sixty to eighty feet high and two to three feet in diameter, exceptional trees reach 110 feet and may be five feet in diameter.

Of the four American mem-



The densely foliaged, well-rounded crown of Black Tupelo contains many small, up-reaching branchlets and as shown by the winter view to the left, the upright trunk frequently extends well into the top



G. H. Collingwood

“blackgum,” and also for the name “pepperidge”—an old English corruption of barberry, because like the barberries, the tupelo berries are acid. Tupelo is an Indian name.

The simple, alternate leaves are oval and pointed, broadest above the middle and with wavy margins. They are of leathery texture, dark green and smooth on the upper surface, slightly downy underneath, and densely clustered on the branchlets.

Similar to its relative, the dogwood, the bark of black tupelo is reddish brown and broken into deep irregular ridges and lozenge-shaped plates. On old trunks the bark may be an inch or more thick. The angular plates are larger than those of dogwood.

The yellow to light brown wood has inconspicuous annual rings and a twisted grain that makes it tough and difficult to split. When air dry a cubic foot weighs about 35 pounds. Considerable amounts are cut into veneer to be manufactured into boxes, baskets, and berry crates, and to serve as a core on which veneers of rarer woods are glued. Without natural ability to resist decay, the wood may be successfully treated with creosote or other preservative. Because of its toughness it was formerly used for ox yokes and chopping bowls, and is now used for flooring, rollers in glass factories, hat-makers' blocks, gunstocks, and pistol grips.

The stand of four species of tupelo is estimated at 18,957,000,000 board feet and is made up almost entirely of water tupelo and black tupelo. The total cut of tupelo lumber in 1946 was about 500,000,000 board feet. Probably over one-half of this was black tupelo. Louisiana, North Carolina, Georgia and South Carolina were the principal producers.

The moist location of most of the trees and the thick bark combine to protect this tree from fire, but the shallow root system frequently causes trees to give way to high winds. Mature trees are frequently subject to heart rot.

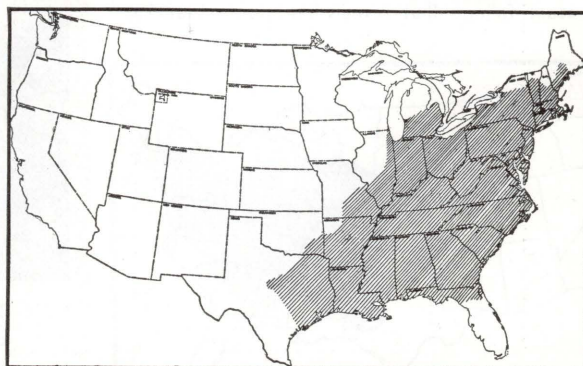
The erect trunk, shapely crown, and gorgeous scarlet autumn foliage combine to make black tupelo an attractive ornamental tree, especially suited to wet or swampy soils.



Upper left: The densely clustered, dark green leaves are two to five inches long, light silvery beneath, and arranged alternately. Right: Inconspicuous greenish flowers appear with the new leaves in early spring



Irregular ridges and lozenge-shaped plates build up a reddish brown bark an inch or more thick



Natural range of Black Tupelo in the United States

BLACK WALNUT

Juglans nigra, Linnaeus

BLACK walnut is common to the eastern half of the United States, and southern Ontario. In the deep alluvial soils from Maryland, Pennsylvania, and Virginia, west into eastern Iowa and Missouri, trees have grown 150 feet high and six feet in diameter with clear lengths of fifty or sixty feet, while trees with a breast high diameter of three feet and 100 feet high are fairly common.

Juglans is a contraction of *Jovis glans*, a Latin name designating the nut or acorn of Jupiter, while *nigra* may refer to the

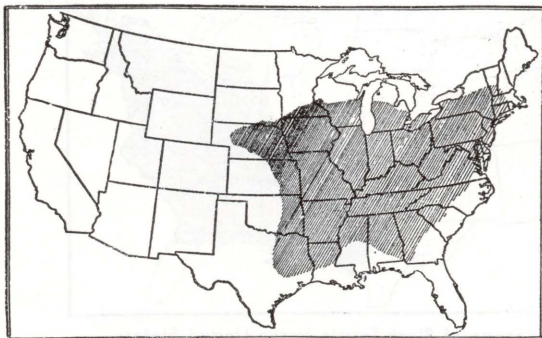
black bark, the rich brown wood, or the dark outer shell of the nut. The Indians in central New York called it "Dent-soo-kwa-no-ne," or round nut.

Closely related to the butternut or white walnut, *Juglans cinerea*, it has two relatives in California and the southwest, and belongs to the same genus as the Persian walnut, whose nut is marketed as English walnut, and lumber as Circassian walnut.

The compound leaves are one or two feet long with fifteen to twenty-three lance-shaped, sharply-toothed leaflets attached to a slightly hairy stem. The globular, light green fruits are an inch and a half to three



Black Walnut forms a round-headed tree with relatively scant foliage that reveals the sturdy branches



Natural range of Black Walnut in the United States



The leaves begin to drop in the early fall exposing a sharply divided trunk and a sturdy framework of heavy alternate branches. The dark brown, occasionally black bark is broken into prominent, rounded ridges, becoming two to three inches thick on older trees

inches in diameter, consisting of a thick pulpy hull surrounding a single nut whose hard, deeply grooved shell protects a kernel of unusual flavor. Each tree bears staminate or pollen-bearing catkins on the previous year's growth, and pistillate flowers in groups of two to five at the ends of the new growth, during April or May.

In winter, walnut trees may be distinguished by the sturdy crown, dark deeply grooved bark, stout twigs, and the large gray, downy, terminal buds. The smaller, downy side buds are alternate, and above a heart-shaped, three-lobed leaf scar, with three V-shaped bundle scars. The diaphragms of the chambered pith of black walnut are thin and pale buff while those of butternut are dark and coarse.

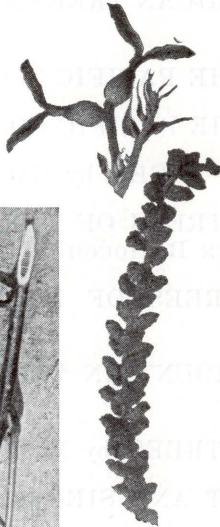
The soft brown, coarse-grained, easily worked wood weighs about thirty-nine pounds to the cubic foot, when air dry. For many purposes it is stronger than white oak, and has been used since earliest American history for fine furniture and interior panels as has Persian walnut in the Old World. It ranks as America's foremost cabinet wood. Walnut's ability to stay in place after seasoning, its good machining properties, slight coarseness and uniformity of texture, and its strength and shock-resisting ability without excessive weight, explains its wide acceptance for gun stocks and, during World War I, for airplane propellers. The heartwood is highly resistant to decay.



Upper right: Two walnuts in their green husks maturing on the end of a current year's leafy twig

Center: Pistillate or nut-producing flowers, and a catkin of pollen-bearing flowers in April or May

Lower left: The compound leaves of Black Walnut have fifteen to twenty-three leaflets. A slanting cut across the twig reveals the chambered pith



The nut or seed has a hard deeply chiseled shell (Natural size)



Because the tree grows singly or in small groups, no figures are available on stand in connection with forest surveys. A conservative estimate made in 1942 places the total at 900,000,000 board feet. The 1946 lumber cut was 41,000,000 board feet. Missouri and Kansas are the leading states in lumber production. In addition, about 15,000,000 board feet is used annually in veneer manufacture.

The nuts mature in a single season, during September and October, and frequently remain on the trees a week or two after the leaves have fallen. They are prized by squirrels.

The kernels are used by confectioners, bakers and makers of ice cream, because the distinctive flavor and texture is not lost in cooking. The nuts may be planted during the autumn or husked and stored in a cool cellar, embedded in sand or in a pit a foot or more underground, preparatory to being planted in early spring. They do best when spaced twenty-five to thirty feet apart, and prove satisfactory along roadsides and on lawns, because the comparatively light shade cast by the leaves interferes little with the growth of grass. Black walnut trees prosper best in deep, rich, well drained soil where moisture is plentiful. They grow readily from seed and for two or three years are easily transplanted so that trees have been set out in every state.

Walnut is relatively resistant to fungus and insect attacks. Tent and walnut caterpillars are sometimes disfiguring but rarely kill the trees, and the leaves are subject to leaf spot diseases which are unsightly but not particularly harmful.

Under desirable conditions black walnut ranks among the rapid-growing American hardwoods, attaining heights of thirty to forty feet and breast-high diameters of five to nine inches in twenty years. It will stand little shade from other trees, and drops the lower branches early so as to develop a relatively high crown.

SELECTED BIBLIOGRAPHY

A complete list of the books and periodicals read in the preparations of these tree descriptions would cover several pages. The following, however, comprise the more important sources of technical information used in the text:

AMERICAN FOREST TREES, by HENRY H. GIBSON.

AMERICAN WOODS—Leaflets on individual tree species prepared by
H. S. BETTS, United States Forest Service.

BOOK OF THE BROADLEAF TREES, by F. H. LAMB.

CHECK LIST OF THE FOREST TREES OF THE UNITED STATES,
United States Forest Service.

CONE BEARING TREES OF THE PACIFIC COAST, by N. A. BOWERS.

CULTIVATED EVERGREENS, by LIBERTY HYDE BAILEY.

DISTRIBUTION OF IMPORTANT FOREST TREES OF THE UNITED
STATES, by E. N. MUNNS.

FIELD BOOK OF AMERICAN TREES AND SHRUBS, by F. SCHUYLER
MATHEWS.

FOREST TREES OF THE PACIFIC SLOPE, by GEORGE B. SUDWORTH.

FOREST TREES OF THE PACIFIC COAST, by W. A. ELIOT.

GUIDE TO SOUTHERN TREES, by HARRAR and HARRAR.

HANDBOOK OF THE TREES OF THE NORTHERN STATES AND
CANADA, by ROMEYN B. HOUGH.

MANUAL OF THE TREES OF NORTH AMERICA, by CHARLES
SPRAGUE SARGENT.

NORTHERN ROCKY MOUNTAIN TREES AND SHRUBS, by J. E.
KIRKWOOD.

PACIFIC COAST AND TREES, by McMINN and MAINO.

REDWOODS OF COAST AND SIERRA, by JAMES CLIFFORD SHIRLEY.

ROCKY MOUNTAIN TREES, by R. J. PRESTON.

SOME AMERICAN TREES, by WILLIAM B. WERTHNER.

STUDIES OF TREES IN WINTER, by BLAKESLEE and JARVIS.

TEXTBOOK OF DENDROLOGY, by HARLOW and HARRAR.

TREE ANCESTORS, by EDWARD W. BERRY.

TREE BOOK, by JULIA E. ROGERS.

TREE FLOWERS OF FOREST, PARK, AND STREET, by WALTER E.
ROGERS.

TREES AND SHRUBS OF THE ROCKY MOUNTAIN REGION, by
BURTON O. LONGYEAR.

TREES OF NORTH AMERICA, by GEORGE REX GREEN.

TREES OF THE NORTHEASTERN UNITED STATES, by H. P.
BROWN.

TREES OF THE SOUTH, by CHARLOTTE HILTON GREEN.

TREES OF THE SOUTHEASTERN STATES, by COKER and TOTTEN.

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WHAT IS THE AMERICAN FORESTRY ASSOCIATION?

The American Forestry Association was created in 1875 for the advancement of intelligent management and use of forests and related resources of soil, water, wildlife and outdoor recreation.

AFA is an independent and non-political organization. It is the oldest national conservation association in America.

AFA is a membership organization of some 20,000 members in the United States and 49 foreign countries.

AFA policies are guided by its elected officers and board of directors. Its work is conducted by a staff from its own home in the Nation's Capital.

AFA in addition to its membership services, publication of AMERICAN FORESTS and its books, engages in special projects of timely interest.

AFA's activities are supported by its membership dues, donations, sale of publications, and interest earnings from its life and patron member endowment fund.

AFA's work is strictly educational and for this reason all contributions and memberships are tax deductible.

ACTIVITIES OF THE AMERICAN FORESTRY ASSOCIATION

American Forests

official monthly publication made available to members since 1898, the country's outstanding illustrated magazine featuring conservation problems and progress, timely news, helpful hints and legislative coverage.

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conducted by the staff for members on specific questions and with private business, industrial and organization groups on special problems and projects.

Publications

for general distribution, such books as KNOWING YOUR TREES, AMERICAN CONSERVATION, TEACHING CONSERVATION, TREES EVERY BOY AND GIRL SHOULD KNOW, Smokey Bear, American Forestry Progress, 1945-1949; The Muskingum Story, Managing Small Woodlands.

Research Surveys

just completed—an appraisal of all phases of American forestry progress in the 5-year period, 1945-1949. Also a fact-finding analysis of the Muskingum Watershed Conservancy District in Ohio.

Special Services

cooperative projects with ECA, foreign foresters' job training, getting American forestry books to foreign libraries, 10% book discount for members.

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with state forestry associations to strengthen local progress, and in sponsoring meetings for businessmen, industrialists, landowners and conservationists to see forestry techniques at the "grass roots."

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annually sponsored horseback and canoe trips into the remote wilderness areas of the national forests and parks.

